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THE ETIOLOGY OF PULMONARY ABSCESS[1]

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PULMONARY abscess may be defined as a localized necrosis and liquefaction within the parenchyma of the lung, due to infection. This suppuration may have its origin either in the lung parenchyma, in the bronchial tree, or by extension from an adjacent suppurative process. The abscess may be associated with or may be the result of pneumonia and other diseases of the lung, it may be secondary to aspiration of infected materials into the lung, or it may be the result of infarct secondary to infected pulmonary embolus. It may result also from injuries to the chest and intrathoracic organs from blunt trauma, bullet wounds, stab wounds, or from an extension of infection through the diaphragm.

HISTORICAL

Our earliest written records of pulmonary abscess are to be found in the works of Hippocrates (17), who recognized abscess of the lung as such and considered aspiration of blood and mucus as the cause of the disease. He taught that a pulmonary abscess that had burst into the pleural cavity could be healed by draining the latter and to that end he described a method of thoracotomy. From the time of Hippocrates in the fourth century B.C. no written records appeared on pulmonary suppuration until 1584 A.D. when Schenk (38) called attention to this condition. He is credited with a case in which he promoted spontaneous rupture by fomentations. Baglivi (3) in 1696 is said to have established drainage by intercostal incision. Other early workers in this field were Barry, Campardon, Sharpe, and Pouteau. In 1793 Gumprecht (12) published a monograph on the diagnosis, prognosis, and treatment of pulmonary abscess. He states that before surgical treatment is instituted it is necessary to determine the presence and seat of pus and the condition of the pleura as to adhesions.

J. B. Murphy (28) classifies the various etiological factors under 9 separate headings as follows: (1) acute circumscribed inflammation, as pneumonia, followed by necrosis and softening of the lung (46 per cent), (2) peribronchitis, (3) septic embolism of the pulmonary artery or a single branch of the bronchial, (4) rapid tuberculous caseation and necrosis with secondary infection, (5) perforation of the lung by infection from malignant diseases of the œsophagus and mediastinum, (6) subphrenic perforations into the lung with retention, (7) foreign bodies in the bronchi, (8) infections following injuries, and (9) suppurative inflammation around calcareous deposits, the latter either a sequence or a cause of the suppuration. In his classification Murphy makes no mention of aspiration of infected material other than foreign bodies. More recent studies bear out the original Hippocratic theory that aspiration of infected blood is of great importance as a cause of abscess.

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Fig. 1. Dog 3063. Implantation of a roasted peanut on August 22, 1927. The animal was killed on September 19, 1927.

Claytor (5) in 1916 reported 4 cases with recovery. In a study of 227 cases, Lord (26) found that in 78 cases the etiological factor was an operation about the upper respiratory tract and in 49 per cent of these cases the operation was a tonsillectomy. On the basis of these statistics he stated: "On the whole the impression is that ingress of infected material from above into the deeper parts is regarded as the chief cause of pulmonary abscess."

Hedblom (13) states: "Aspiration of infected material appears to be a more frequent cause of abscess than is generally recognized. Of considerable interest and importance are the apparently relatively frequent lung abscesses following tonsillectomy."

Lemon (24) carried out a series of experiments to study 4 different factors relative to pulmonary aspiration, namely, (1) to learn whether or not aspiration does occur when the animal is anæsthetized, (2) to discover some of the factors necessary to permit aspiration, (3) to evaluate the accidents that may occur during anæsthesia and their relationship to aspiration, and (4) to learn the result of ether anæsthesia on some of the recognized protective mechanisms of the lung. The results of his experiments are as follows: (1) when the dogs under anæsthesia lie on a plane inclined at various degrees, aspiration occurs regardless of whether the anæsthesia is light or deep. No aspiration occurred in non-anæsthetized dogs. (2) The position of the head relative to the body seems to make little if any difference in the amount of material aspirated. (3) When there is a relatively large amount of fluid material, aspiration by suction pump fails to prevent the downward course into the lung. (4) In almost every instance the fluid preceded the particulate matter. (5) When the head of the animal was 28.75 centimeters lower than the feet, aspiration did not occur.

In the discussion of Lemon's paper, Hedblom (14) called attention to the fact that "pulmonary infection in man following aspiration must depend largely upon the nature or the virulence of the infective organisms or both. This experimental work," he continues, "certainly seems significant as supporting the view that most of the cases of pulmonary suppuration that follow nose and throat operations are due to aspiration of infected material." At that time the hope was expressed by Hedblom that investigations be pursued in the direction of determining the rôle that different types of infection may play in the production of pulmonary lesions.

Myerson (29) in a bronchoscopic study of 100 cases undergoing tonsillectomy under light general anæsthesia found that the abolition of the cough reflex is of great importance in aspiration. In 78 cases the cough reflex was abolished and in 72 of these cases he noticed blood and mucus below the larynx. In 22 out of the 100 cases the cough reflex was not abolished. In only 4 of this number did he notice blood and mucus below the larynx. We agree with Myerson (30), that the failure to expel aspirated material is more important than the aspiration itself. By keeping this factor in mind and causing the infected blood to be entrapped in the alveoli we were able to produce abscesses in over 70 per cent of our dogs.

That the aspirated blood reaches the alveoli very readily is proved also by the work of Corper (6). He observed that under ether anæsthesia aspiration of fluids after instillation into the nose occurred readily in dogs and rabbits placed in the horizontal position. In the non-anæsthetized animal lying in a horizontal position, however, repeated nasal

instillations did not cause aspiration. On the other hand, with the non-anæsthetized animals in the vertical posture the aspiration of fluids was easily attained in rabbits, but less so in dogs, the fluid being found mainly in the lower lobes. Corper also found that particulate matter such as carbon particles are found heaped up at the points of bifurcation of the air passages with relatively little being retained in the alveoli. In another series of experiments he traced the aspirated fresh blood to the alveoli of rabbits as late as 4 weeks after the intratracheal injection. At the site of the blood localization the presence of a distinctly palpable induration was noticed. This was due to a proliferative pneumonitis occasioned by the presence of blood in the finer pulmonary subdivisions. This induration was found to persist longer than 4 weeks.

Herb (16) made an extensive study of the effects of anæsthesia on the lungs. She states that ordinarily ether is not any more likely to produce lung complications than a local anæsthetic, especially if the ether is administered properly. She condemns the use of the closed mask and quotes the work of Dresser (11) who found that "the ether vapor within the closed mask sometimes reached a concentration as high as 34 per cent while 6 or 7 per cent is the strongest concentration which may be inhaled without irritation to the air passages." In addition to aspiration, other factors important in the production of lung complications are weak heart action, low blood pressure, generalized sepsis, cooling of the body surface, diminished lung expansion caused by pain or tight bandages, and morphine which reduces the cough reflex.

FUSOSPIROCHAETÆ AND PULMONARY ABSCESS

The most fruitful research in pulmonary abscess has been the study of fusospirochætæ. As early as 1866 Leyden and Jaffe (25) were inclined to incriminate a variety of the leptothrix as the cause of pulmonary suppuration. In 1898 Withington (42) expressed his belief that bacteria may play a part in abscess formation. He quotes Babes (2) as saying: "The saprophytes cannot of themselves produce gangrene but are inevitably associated

Fig. 2. Dog 2598. Roentgenogram taken 17 days after implantation of bean and showing dense shadow at site of implantation.

with some other organism, generally the pyogenic coccus." Thus in 12 cases he found the association to be with staphylococcus, in 12 with streptococcus, and in 3 an extremely virulent pneumococcus. "Indeed all these cocci showed remarkable virulence. But these of themselves could only effect suppuration or necrobiosis, while upon the soil thus made ready the saprophytes found a favorable condition for growth. Other concomitant microbes were those of diphtheria in 10 out of 24 cases." Thus, given a receptive soil which is produced by diminished resistance in the lung tissue, implantation of the saprophyte is believed to be the final stage in the production of abscess or gangrene.

The recognition of spirochætal pulmonary gangrene as an entity is attributed by Maes (27) to Castellani, who described the disease in 1903. Castellani (4), himself, however,

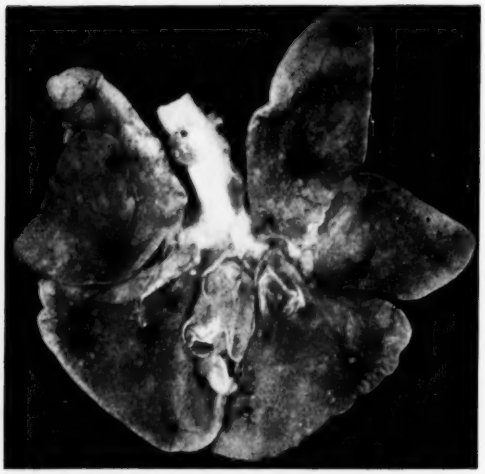

Fig. 3. Dog 3149. Died 17 days after sinus operation. Note the perforated ulcers in the left upper lobe.

Fig. 4. Dog RD 2. Intrabronchial injection of 10 cubic centimeters of tonsillectomy blood, April 12, 1927. The dog died 3 days later.

states: "Spirilla or spirochætæ have been occasionally seen in bronchial discharge by several authors (Eichorst, etc.) but the parasites apparently were present in small numbers only."

Pilot and Davis (35) noted that when the dental tartar is examined fresh, it presents brush-like processes having central strands with coccoid and fusiform bodies arranged about the terminals. In the smear they found large numbers of coarse and fine spirochætæ, fusiform bacilli of various types, leptothrix filaments, and gram-positive streptococci of the hæmolytic or viridans type. In an anaerobic culture, the fusiform bacilli produced a putrid odor in the tissue media.

In the faucial tonsils, Pilot and Davis (35) found these "organisms in large numbers in the granular masses lying in the crypts, which in their appearance were like actinomyces granules. These bodies are found in 30 per cent of extirpated tonsils and at some time are probably present in all individuals. They appear as foul, gray or yellow, single or multiple granules from 1 to 6 millimeters in diameter, lying in the depths of the mouths of the crypts, from which they may be expressed. Microscopically they are made up of filaments arranged in ray-like structure, not unlike actinomyces but certainly with no true branching threads. They form a central shaft about which are small comma-shaped, fusiform bacilli and spirochætæ together with diplococci. The spirochætæ are gram-negative and actively motile. The cocci are chiefly streptococci of viridans or hæmolytic type, the former often anaerobic in early cultures. The bacilli are demonstrable in smear of culture in 80 per cent of extirpated tonsils. It would seem that a process similar to that of tartar formation occurs in the tonsil with the formation of spherical structures in the crypts instead of a film."

That these organisms are pathogenic and are not normal inhabitants of the mouth was proved by Davis and Pilot who found these organisms in putrid and gangrenous lesions of the body, particularly about the teeth, tonsils, middle ear, lungs, and the genitalia. They reported 37 cases of pulmonary suppuration in which the fusospirochætæ were found.

In addition to the work of Pilot and Davis we have the reports of fusospirochætal pulmonary suppuration by B. S. Kline (21) and his co-workers, Rona in 1905 (36), Rothwell in 1910 (37), Peters in 1911 (33), Dick in

1913 (10), and in 1918 the reports of Nolf (31), Parof (32), Thomson (40), and Weil (41). From this time on quite a large number of reports appeared in the literature.

Predisposition to fusospirochætal infection depends on many factors, but as a rule the patients are weakened by other causes. Local foci such as pyorrhœa or tonsils infected with fusospirochætæ are of utmost importance. Pilot and Davis (35) state that the normal lungs do not harbor these organisms. They could not find them in 14 pairs of lungs which were free from any infectious process. On the other hand in certain abnormal conditions such as bronchiectasis, chronic bronchitis, and bronchial asthma, they found fusospirochætæ in the sputum, but the latter was not foul. These organisms under such conditions apparently lead a saprophytic life, but in the presence of an acute respiratory infection or if the general resistance is lowered, these saprophytic anaerobes may cause a putrid bronchitis and after spreading through the necrotic bronchial mucosa reach the lung parenchyma and produce single or multiple foci of suppuration or gangrene.

Experimental production of pulmonary abscesses has been successfully carried out only recently. Cutler and his associates (9) produced embolic lung abscesses. Aspiratory lung abscesses have been produced by Smith (39) in mice, guinea pigs, and rabbits. Within the last year Smith's work was carried to completion by the production of experimental aspiratory abscess in dogs by Crowe and Scarff (8), Duff Allen (1), and Hedblom, Joannides, and Rosenthal (15). Recently Pilot (34) succeeded in producing aspiratory lungs abscesses by injecting intratracheally material containing fusospirochætæ into the lungs of rabbits and keeping the organisms down in the lung by using lipiodol.

Fig. 5. Dog 2981 (above). Injection of 30 cubic centimeters of blood and abscess sputum on July 13, 1927, followed by death 4 days later. Dog 2986 (below). Injection of 30 cubic centimeters of blood and abscess sputum on July 13, 1927, followed by death 3 days later.

EXPERIMENTS AND RESULTS

Implantation of foreign bodies, peanuts, agar agar, navy beans, pennies. We began our experiments with this series because we felt that an implanted body would not be likely to be coughed up and would remain in the lung a sufficient length of time to cause the expected damage. We performed 14 such experiments on dogs. The substances implanted were roasted salted peanuts with their inner shell, agar agar, dry navy beans, and pennies. The technique of implantation was a modification of the one developed for lobectomy by Joannides (19). Under aseptic conditions an intercostal incision was made. Compressed air was used for the artificial respiration and sufficient pressure was exerted to allow the lung to expand moderately. An intestinal clamp with rubber tips was used to prevent air and blood leakage. With the lobe then immobile the lung was brought to the surface, a small opening made in it, and the foreign body then implanted. The lung was sutured with a Garre suture and after the release of the clamp at the hilum the chest was closed.

Before closing the chest we examined the lung wound to see if it was air and water tight. The ribs were then approximated with heavy suture, and the overlying tissues were closed in layers.

In the 14 implantation experiments we were unable to produce a characteristic lung abscess, but always obtained a thick walled cyst surrounding the implanted foreign body. In 3 dogs we implanted salted roasted peanuts, in 4 dogs small pieces of agar agar containing a small piece of lead so that it could be localized by the roentgen ray, and in 1 dog a penny was implanted. In the 6 remaining

Fig. 6. Dog 2989. Intrabronchial injection of 30 cubic centimeters of fresh dog blood and abscess sputum, followed by death 8 days later.

dogs we implanted dry navy beans (Fig. 1). On the basis of this series we may assume with reasonable certainty that a foreign body implanted in the lung of a dog does not ordinarily produce an abscess, unless it is infected with organisms that produce either gangrene or bacillus infection. The lung tissue of the dog apparently has a high degree of resistance and can overcome mild ordinary infection either by expelling these organisms through the bronchial tree or by walling off the irritating substance with a thick wall and thus rendering it innocuous (Fig. 2).

Implantation of products of pulmonary abscess into paranasal sinus. We performed 9 experiments in which we opened the frontal sinus by means of a trephine wound and implanted a cotton pledget saturated with material obtained from a patient with a pulmonary abscess after the method of Crowe and Scarff (8). This contained fusiform bacilli, spirochætæ of Vincent, diphtheroids, gram-positive diplococci, hæmolytic streptococci, and gram-negative bacilli. In 3 out of 9 dogs (or 33⅓ per cent) we obtained abscesses in the lung 17, 63, and 70 days after the nasal operation. The 6 remaining dogs were allowed to live for from 2 to 4 months and at autopsy they showed no lung pathology whatever. Dog 3149 was operated upon on October 14, 1927. Morphine-hyoscine analgesia was used. The animal was placed on its abdomen and under aseptic conditions the bone was exposed in the midline. With a small trephine an opening 1 centimeter in diameter was made in the bone. The opening was packed for a few minutes to stop the hæmorrhage, and then a cotton pledget was inserted into this trephine opening. The pledget was soaked with sputum obtained from a pulmonary abscess patient under Dr. Hedblom's care. This patient raised about 700 cubic centimeters of sputum daily and this contained the characteristic fusospirochætal combination. The dog developed snuffles and from time to time we noticed a moderate amount of cough. The animal died on October 31, 1927, or the seventeenth postoperative day and at autopsy we found a diffuse pleurisy with hæmorrhagic effusion and two small abscesses that perforated into the pleural cavity from the right middle lobe (Fig. 3). Smears from the effusion and the ulcers showed no spirochætæ of Vincent. We did find, however, fusiform bacilli, diphtheroids, and gram-positive diplococci. Smear from the nasal sinus showed the same findings.

Dog 3092 was operated upon on September 9, 1927, and died November 11, 1927, 63 days after operation. At autopsy a mediastinal abscess was found at the level of the second and third dorsal vertebræ. It was the size of a walnut and contained thick foul smelling pus. On both sides of the chest there was a total of one quart of thick bloody fluid with flakes of thick grayish yellow pus. In the left lower lobe an abscess about the size of a 25-cent piece was found with walls collapsed and approximated to each other. The abscess cavity contained a thick mucus. The lung at this point was adherent to the diaphragm by means of thin fibrous adhesions. The right lung was purple and doughy. Following incision into the right lung a dark brown fluid exuded from the tissues.

The third dog, No. 3145, was operated upon on October 14, 1927, and was killed December 22, 1927, 70 days after operation. The sputum with which we infected the sinus contained a high proportion of spirochætæ in addition to the fusiform bacilli and the usual accompanying organisms. This animal was killed by means of a subcutaneous injection of potassium cyanide. The right lower lobe presented an abscess the size of a 25-cent piece. Following incision of the lung at the site of the abscess a thick reddish gray pus was obtained when slight pressure was exerted on the walls of the abscess. The rest of the lung was grossly negative. A dissection of the bronchial tree showed a thick, sticky mucous discharge throughout the bronchial tree.

Intrabronchial injections of citrated tonsillectomy blood. Ten cubic centimeters of citrated tonsillectomy blood was injected through a bronchoscope into each of 2 dogs. One dog was killed and showed no abscess of the lung. The second one (Dog RD2) received the injection on April 12, 1927, and died on April 15, 1927. At autopsy the right lower lobe

showed a massive gangrene with an abscess involving the right lower and mediastinal lobe. The abscess was 6 centimeters in diameter and the lung at the site of the abscess was adherent to the diaphragm (Fig. 4). There was a bilateral pleurisy with hæmorrhagic effusion. Smears from the abscess showed many fusiform bacilli and few spirilla gram-positive diplococci and streptococci.

In another series of 3 dogs 20 cubic centimeters of the same blood were injected into the lung through the bronchoscope, and all 3 dogs died on the day following the injection. Two showed a massive pneumonia with pleurisy and effusion. The third dog (Dog 2801) showed an abscess the size of a 10-cent piece in the right lower lobe and a massive pneumonia in the rest of the lung. Smears from the abscess area showed bacillus fusiforms, gram-positive diplococcus, diphtheroids, micrococcus catarrhalis, gram-negative bacillus, but no spirochætæ of Vincent.

Intrabronchial injection of citrated tonsillectomy blood and mixed with tonsil tissue and scrapings from the teeth of patients with pyorrhœa alveolaris. Six experiments were performed in this group. In each of 3 dogs we injected 10 cubic centimeters of 24-hour-old citrated tonsillectomy blood mixed with pyorrhœa scrapings and small pieces of tonsil tissue. One dog (No. 2811) died 2 days after the injection. At autopsy this dog showed multiple abscesses in the right lung. These abscesses varied from 2 to 5 millimeters in diameter. A large abscess 1 centimeter in diameter was found in the upper right lobe. This area was adherent to the chest by means of fibrous adhesions. The bronchi were filled with thick purulent fluid extending into the finer ramifications. The left lung presented a massive pneumonia with pleurisy but no effusion.

The second dog (No. 2810) died 6 days after the injection and presented a bilateral pneumonia with pleurisy and hæmorrhagic effusion, but no abscess. The third dog (No. 2809) was killed 7 weeks after the injection. No abscess could be found. Both lungs were in a state of red hepatization. Clotted blood was found in the trachea and the larger bronchi leading to the upper left lobe.

In each of the 3 remaining dogs of this group 20 cubic centimeters of this mixture was used. It is striking to notice that in spite of the larger amount of blood used we found no abscesses in the lungs of any of these dogs. The blood used was from the same source in this entire group. The patient had had quinsy 2 months previous to tonsillectomy. On microscopic examination of the tonsil we found the characteristic fusospirochætal combination.

Intrabronchial injection of gastric contents, with or without pyorrhœa scrapings, bits of teeth, and tonsillectomy blood, during an abdominal operation. In a series of 5 dogs we introduced into the lung through a bronchoscope, human gastric contents containing 52.4 free hydrochloric acid and 66.4 total acidity. One dog (No. 2803) that received 10 cubic centimeters of the gastric contents on May 4, 1927, was killed on June 2, 1927, 29 days after the injection and at autopsy presented an abscess of the mediastinal lobe. Of the 4 remaining dogs 1 died 24 days after the injection and neither the lungs nor pleura showed any pathology whatsoever. The 3 other dogs died at 2, 3, and 5 days, respectively, after the injection, showed an extensive bilateral pneumonia and pleurisy with hæmorrhagic effusion, but presented no abscess formation. Dog 2803 appeared very sick 2 days before death. The animal was killed by means of an intracardiac injection of chloroform and at autopsy presented an abscess the size of a nickel in the mediastinal lobe. No fluid or adhesions were found in the chest.

Fig. 7. Dog 3017. Intrabronchial injection of 30 cubic centimeters of fresh dog blood and sputum from clinical pulmonary abscess. Death occurred in 12 days.

We tried this same experiment in a group of 3 rabbits and 3 guinea pigs. In these animals we injected the gastric fluid through a tracheal needle. One rabbit, that died 4 days after the injection of 1 cubic centimeter of the mixture, developed an abscess of the left upper lobe. The remaining animals showed pneumonia but no abscess.

In 3 dogs we performed an abdominal operation while a mixture of gastric contents, bits of teeth, pyorrhœa scrapings, and 24-hour-old tonsillectomy blood was slowly injected through a bronchoscope into the lung. In Dog 2839 we injected 15 cubic centimeters of this mixture on May 27, 1927, and killed the dog on July 5, 1927. At autopsy we found a hard mass in the right upper lobe, but on sectioning we found no fluid or foreign body in the center of this mass. The 2 other dogs were killed 1 month after the injection. In 1 dog we found no lung or pleural pathology while in the other we noticed that the lungs were speckled with small hæmorrhagic areas which on sectioning showed clotted blood. We also noticed small bullæ in the visceral pleura but found no typical abscesses.

In 2 dogs we injected the dog's own freshly clotted blood after it was mixed with bits of teeth from a pyorrhœa patient. Twenty cubic centimeters were slowly injected in each of these dogs while an abdominal operation was being performed. Dog 2874 was injected on June 7, 1927, and died on June 10, 1927. At autopsy we found a bilateral pneumonia and an abscess in the mediastinal lobe. The other dog died 6 days after the injection and presented no lung or pleural pathology.

These experiments tend to show that gastric contents *per se*, when aspirated, may cause a pulmonary abscess. Whether or not an abdominal operation is of any importance in the production of abscess of the lung, depends entirely upon one factor. If during an abdominal operation the patient vomits, if the head is raised higher than the level of the feet, if the anæsthesia during this operation is so deep that the cough and swallowing reflexes are abolished, we have conditions that are favorable to abscess production. That the abolition of the cough reflex is very important in the development of abscess of the lung was impressed upon us when we saw repeatedly the mucus, blood, or gastric contents that we injected come right up into the mouth when the animal was not deeply anæsthetized. Moreover, in one animal we introduced a tooth through the bronchoscope. As soon as the tooth was blown in we inserted the thumb to close the opening of the bronchoscope. The tooth was blown back very promptly and with such a force that it pierced the thumb and caused an infection.

Intrabronchial injection of a broth suspension of pyorrhœa scrapings or abscess sputum mixed with small pieces of infected teeth or with small pieces of fresh tonsil tissue. In 2 dogs we injected 10 cubic centimeters of broth suspension of pyorrhœa scrapings mixed with small bits of infected teeth. Both dogs were killed 38 days after the injection. Dog 2828 received the injection on May 17, 1927, and was killed on June 20, 1927. At autopsy we found 2 small abscesses in the right upper lobe. On section pus exuded from these abscesses. Dark field examination of the scrapings showed a large number of spirochætæ of Vincent. The smear showed many fusiform bacilli, diphtheroids, and gram-positive diplococci. The second dog presented no lung pathology when killed 38 days after the injection.

In each of 7 dogs we injected 10 cubic centimeters of sputum from a pulmonary abscess patient of Dr. Hedblom. The smear of the sputum showed the characteristic fusospirochætal combination. We obtained abscesses in 2 of these dogs. Dog 2890 received the injection on June 8, 1927, and died on June 10, 1927. At autopsy we found a bilateral pneumonia and an abscess of the mediastinal lobe with thin fibrinous adhesions between this lobe and the diaphragm. Dog 2889 received the injection on June 8, 1927, and was killed on June 29, 1927. At autopsy we found abscesses in the left upper and right lower lobes. The 5 remaining dogs did not develop abscesses.

In each of 3 dogs we injected 15 cubic centimeters of abscess sputum and also implanted small pieces of fresh tonsil tissue. One dog died 8 days after the injection and at autopsy showed a pneumonia of both lower lobes but no abscess. The 2 other dogs were killed 13 and 20 days after the injection and at autopsy neither showed any lung pathology.

The percentage of abscess formation in these dogs was not very high because the sputum could be easily coughed up as soon as the animal woke up. In spite of the cough, abscesses have occurred in these dogs. If, on the other hand, we suspended this sputum in a fluid that would be entrapped in the alveoli the percentage of abscesses would naturally be higher. Fresh blood or freshly clotted blood would make an ideal medium for such experiments because the fibrin meshes would have a greater cohesive power in the lung and at the same time shut off the air supply of the part, thus producing favorable anaerobic conditions. We tried this procedure in our next series and obtained an unusually high percentage of abscesses.

Intrabronchial injection of fresh or freshly clotted dog's own blood mixed with sputum from a patient with lung abscess. We injected this mixture into 14 dogs. In 10 of these animals we obtained either single or multiple abscesses. The abscesses varied in size from a few millimeters to 3 centimeters. Although the lower lobes and the mediastinal lobe were most commonly involved, we found them also in the upper lobe.

Dog 2981 received the injection on July 13, 1927, and died 4 days later. At autopsy an abscess, the size of a 50-cent piece, was found in the mediastinal lobe (Fig. 5). Smears from this abscess showed fusiform bacilli, diphtheroids, and gram-negative bacilli. The abscess ruptured into the pleural cavity and was walled off by means of thin fibrinous adhesions. Both sides of the chest were filled with thick bloody pus. There was an acute anterior mediastinitis while the pericardium was covered with a thick "bread and butter" exudate. The lungs were doughy and did not crepitate. They were of dark purple color.

Dog 2982 received the injection on July 13, 1927, and died 3 days later. At autopsy this dog presented a gangrenous right lower lobe with a ruptured abscess the size of a silver dollar. There was also a smaller abscess in the upper left lobe. There was an acute fibrinopurulent pleurisy and an acute anterior mediastinitis. Both sides of the chest were filled with bloody thick pus. The left upper lobe and right lower lobe were adherent to chest wall.

Dog 2984 died 2 days after the injection. At autopsy much the same findings as in dogs 2981 and 2982 were noticed. The mediastinal lobe had multiple small abscesses.

Dog 2985 died 24 hours after the injection. In addition to gangrene of the mediastinal and the left lower lobes there was a ruptured abscess 3 by 2 centimeters in diameter. The left lower lobe was adherent to the chest wall and the diaphragm.

Dog 2986 died 3 days after operation. At autopsy a ruptured abscess in the left lower lobe was found. Dog 2988 was killed 12 days after the injection, and an abscess in the left lower lobe was found. Dog 2989 died 8 days after the injection and presented an abscess in the mediastinal lobe. This abscess involved the major portion of the mediastinal lobe and was the size of a 50-cent piece (Fig. 6). It contained a thick cheesy mass. There was no communication with the bronchus. The abscess had ruptured into the chest cavity. Dog 3017 died 12 days after the injection and showed multiple abscesses in the right upper lobe (Fig. 7). Dog 3019 was killed 6 days after the injection. At autopsy the lung showed multiple small abscesses in the left lower lobe. Dog 30121 died 4 days after operation and presented an abscess in the mediastinal lobe. Sections from the abscess wall showed characteristic polynuclear infiltration and microscopic abscesses.

Dog 2988 received the injection on July 13, 1927, and was killed on July 25, 1927. An abscess in the left lower lobe was found. Dog 3019 was killed 6 days after the injection and at autopsy presented abscesses in the left lower lobe.

In this series the majority of abscesses were found within the first 5 days after the injection. In 1 case the dog when killed on the twelfth day presented an abscess. These findings are quite in contrast with the paranasal sinus experiments. In these experiments the abscesses were of the chronic type, whereas, in this last series, abscesses were found as early as 24 hours after the injection. The fact that we notice multiple as well as single abscesses in these aspiratory abscesses seems to disprove the contention of certain workers who assume that multiple abscesses are generally embolic in origin. The high percentage of abscess formation in this series is undoubtedly due to the injection of freshly clotted blood. With the formation of fibrin meshes this blood was entrapped in the alveoli and in the presence of the fusospirochætes formed an ideal background for abscess formation.

Intrabronchial injection of pure cultures of staphylococcus aureus and albus mixed with fresh dog blood. Ten dogs were injected with 10, 20, and 30 cubic centimeters of the mixture. Two out of the 10 died 7 and 9 days after the injection. The rest were killed at intervals from 4 to 16 days after the injection. No abscesses were found in any of these dogs. We noticed, however, at various parts of the lung, hard lumps ½ to 1 centimeter in diameter with a hard white center much like the foreign body reactions of other implantation experiments. A dissection of the bronchial tree revealed a thick sticky mucopurulent bronchitis extending as far down as the smaller ramifications of the bronchial tree.

From this group of experiments we can assume with a reasonable degree of certainty that it takes more than blood and pyogenic organisms to cause pulmonary abscesses in the dog. Masses such as those we found in the staphylococcus experiments have been described by Corper, Kretschmer, and Lurie (7). Corper and his associates state that "normal unclotted blood which has been injected intratracheally into rabbits immediately after withdrawal from the internal jugular vein is rapidly aspirated into the finer air divisions where it is retained and induces a proliferative reaction on the part of the pulmonary tissue. . . . After all local pigment has disappeared there still remains a distinctly palpable induration at the site of localization due to proliferative pneumonitis occasioned by the presence of blood in the finer pulmonary division."

Intratracheal injection of blood mixed with bismuth subcarbonate with the animal lying in a horizontal position. We injected 50 cubic centimeters of the mixture into each of 2 dogs and studied the distribution with the X-ray. As expected the bismuth diffused itself fairly evenly throughout the whole lung. We can assume therefore that with the introduction of infected blood no part of the lung would be immune but the greater tendency for involvement would be in the portions of the lung to which the blood would naturally gravitate. This is undoubtedly the reason for the greater frequency of lower lobe or mediastinal abscesses.

COMMENT

Out of a total of 87 experiments we noticed abscess formation in 21 dogs or a total of 24 per cent. By using fresh blood and abscess sputum we were able to obtain abscesses in 10 out of 14 dogs or 71.4 per cent. An implantation of a foreign body infected only with ordinary pyogenic organisms is well tolerated in the dog's lung. A saccule is formed which encapsulates the foreign body and thus makes it innocuous. Intrabronchial injection of blood plus staphylococcus produced changes similar to those found by Corper (7) after the injection of pure sterile fresh blood. Apparently the lung of the dog is immune to the ordinary pyogenes so that when it is injected with fresh blood we can produce only a reaction characteristic of the aspiration of sterile blood. On the other hand, aspiration of either pyorrhœa scrapings or abscess sputum causes a lung abscess. A broth suspension of pyorrhœa scrapings does not cause a high percentage of abscesses. Our experience was the same with the aspiration of plain abscess sputum, which is usually thick and tenacious and on aspiration acts very likely as a large sized foreign body. It undoubtedly stays in the larger branches of the bronchial tree and is easily coughed up as soon as the animal wakes up. Such is our experience also with

the aspiration of larger foreign bodies such as bits of teeth or pieces of fresh tonsil tissue. In not a single dog were we able to find any of these foreign bodies in spite of the most careful search.

Knowing from the experience of Pilot and his co-workers, Smith (39), Crowe and Scarff (8), Duff Allen (1), and Hedblom, Joannides and Rosenthal (15), that the presence of fusospirochætæ is quite important in the etiology of lung abscess and knowing from the work of Corper and others that blood will find its way into the smallest ramifications of the bronchial tree and remain there and become organized we can assume that we have found both the seed and the condition to prepare the soil for such infections. Aspiration of infected fresh blood during or soon after an operation in the nasopharynx has given the highest incidence of postoperative lung abscesses. We have been able to duplicate clinical conditions by infecting fresh blood with fresh abscess sputum rich in fusospirochætes. In 14 such experiments we have been able to obtain single or multiple abscesses in 71.4 per cent of our dogs. In 8 out of 10 dogs which developed abscesses, the lesion was acute and appeared from 1 to 6 days after the intrabronchial injection. It is very likely that the infection was so massive and so many areas became involved that the dogs died promptly. Such was not the case, however, when pyorrhœa scrapings were aspirated. Under such conditions we found an abscess of the right upper lobe in a dog that we killed 38 days after the injection. Chronic abscesses also have been produced as a result of a chronic paranasal sinusitis of the fusospirochæta type. Foul pus rich in fusiforms, diphtheroids, and pyogenes could be noticed in the nose of our animals. In 33.3 per cent of our frontal sinus experiments we found abscess formation. In all cases the abscesses were found after a prolonged period, namely, 17, 63, and 70 days after the sinus operation. There seems to be no doubt that the pus from the sinuses found its way into the lung, thus eventually causing abscess formation.

The introduction of infected material into the lung does not always produce abscesses. In a certain percentage of the animals killed 1 to 100 days after the injection, no lung pathology whatever was revealed. A certain proportion of these dogs showed a unilateral or bilateral pneumonia of the lobar type. The lower lobes and the mediastinal lobe were most frequently involved. Another group of them developed gangrene of the lung, and finally a certain percentage showed abscess of a varying size. Just why one should see all these variations is difficult to tell. It is possible that the protective mechanism in the lung varies with the different animals.

The following factors are of great importance in the production of lung suppuration:

1. The abolition of the pharyngeal and cough reflexes in general anæsthesia.

2. The presence of mucus or blood in the mouth during anæsthesia.

3. The presence of certain characteristic micro-organisms in the buccal cavity (fusospirochætæ).

4. The presence of chronic infection in the nose, mouth, and paranasal sinuses.

5. The dimensions and the physical state of the aspirated material. Thus the smaller the foreign body the further it will reach in the bronchial tree. A thick, tenacious fluid that has a low specific gravity is less likely to stay in the lung than a thinner, less tenacious, heavier fluid.

6. The action of the cilia which clear the trachea and bronchi by rhythmic movement.

7. Specific immunity in the lung against certain organisms. For example, the lesions that are noted after the introduction of fresh blood and a pure culture of staphylococcus aureus and albus are characteristic of the one noticed with sterile blood. It appears that under ordinary conditions the staphylococcus does little harm to the lung of the dog.

The lesions may be single or multiple, acute or chronic. We have been able to produce chronic abscesses by allowing only small amounts of pus to trickle down from the nose of the dog into the lung. On the other hand we have found abscess formation within 24 hours after the injection. The abscesses varied in size from a few millimeters to a size equal to that of 5 centimeters.

Some abscesses ruptured into the pleural cavity and caused a fatal acute pleurisy with

effusion. Usually at the site of the abscess we found fibrinous or fibrous adhesions between the lung and the neighboring organ or the chest wall.

In the acute abscesses a wall was not well formed but in the more chronic types we found a wall 1 to 3 millimeters thick and the contents varied from pus to thick cheesy material. The abscess does not necessarily communicate with the bronchus in these aspiratory experiments. In one experiment in which we obtained the largest abscess, we could find no communication of the abscess with a bronchus. The wall surrounding the abscess was uniformly tough.

The pneumonia that was noticed was usually of the lobar type. In some animals we noticed a pneumonic process in immediate neighborhood of bronchus. This type of lesion was of relatively infrequent occurrence.

Foreign bodies implanted in the lung induced the development of a thick walled foreign body sac that showed no evidence of infection and that surrounded this body very intimately. This lesion was produced by the implantation of peanuts, beans, agar agar, and pennies.

When blood with staphylococcus was injected intrabronchially and the animal developed lesions, we noticed a thick kernel-like induration without a soft center. This varied in color from red to grayish yellow. On section a hard cartilage-like center was found.

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A STUDY OF GANGLION[1]

With Especial Reference to Treatment

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A GANGLION is a cystic swelling usually occurring in close proximity to joints and tendon sheaths and containing a thick mucinous fluid. The regions of the wrist, ankle, and knee and the volar regions of the fingers and hand are most frequently affected.[2]

GENESIS

The many hypotheses dealing with the origin of ganglia have added an interesting chapter to their study. The various arguments that have been advanced show that no definite conclusion regarding their genesis has as yet been reached. Even today many accept the popular belief of the middle of the last century that they are hernial protrusions of synovial membranes or tendon sheaths. The following are brief summaries of hypotheses that have been given.

1. "A knot of tissue." This is, perhaps, the oldest conception of the pathology and the Greek word γάγγλιον from which the word ganglion comes expresses the thought. Hippocrates (10) refers to it and says that it contains "mucoid flesh" (μυξώδεα σάρκα).[3]

2. Rupture of tendon sheath. In 1746 Eller (4) found a ganglion adherent to a tendon sheath. He examined it microscopically and concluded that the sheath had ruptured and that the fluid contained in the ganglion came from the sheath space with subsequent sealing off of the opening made by the rupture.

3. Retention cysts. Gosselin (8) in 1852 thought that they were retention cysts coming from a combination of the "corpuscles sous-synoviaux" and "cryptes synovipares" (subsynovial follicles and crypts).

4. Neoplasms. Henle (9) in 1847 regarded them as "mucinous tumors," Meckel (16) in 1856 as "serous cysts," and Hoeftman (11) in 1876 as "synovial dermoids." Ledderhose (15) in 1893 in addition to considering them degeneration cysts also thought that they were true neoplasms. Floderus (5) in 1915 said that ganglia are true neoplasms arising from an "arthrogenous blastema," i.e., a specialized connective tissue destined through growth and degeneration to form joints and tendon sheaths. On this basis he suggested that ganglia be called "arthromas." Kuettner and Hertel (14) agreed that ganglia were neoplasms.

5. Herniation of tendon sheath or capsule of joint. This hypothesis was discussed by Volkmann (24) in 1882 and by Billroth (1) in the same year. The latter left open the question of communication of ganglia with joints or tendon sheaths.

6. Origin from bursæ. Vogt (23) in 1881 offered this opinion.

7. Degeneration cysts. Ledderhose (15) in 1893 and subsequently Thorn (22), Payr (18), Franz (7), Borchardt (2), Hofmann (12), Ritschl (20), Clarke (3), and Thomson (21) advanced the idea that they were cystic degenerations in the connective tissue outside a joint.

PATHOLOGY

For some years we have been interested in the origin of ganglia. We have made notations of operative findings and have studied pathological sections and the chemistry of the cyst contents. In no instance have we been convinced that ganglia resulted from direct communication with joints or sheath spaces. On several occasions the joint has been exposed but only for one of two reasons, namely, operative trauma or an almost complete disappearance of the capsule; and further, in these instances, the cyst wall has been complete and its contents have had no connection

[2] We have not included cysts of the semilunar cartilages in this study.

[3] "Speaking generally, all other parts of a mucous nature, or which secrete mucus, being viscous slip about readily hither and thither when palpated, wherefore practitioners find them thicker to penetrate than they expect. Thus, in the case of some ganglionic tumors which are flabby and have mucoid flesh, many open them, thinking to find a flux of humors to such parts. The practitioner is deceived in his opinion; but in practice, no harm is done by such a tumor being opened."

[1] Read before the Section of Surgery, New York Academy of Medicine, April 6, 1928.

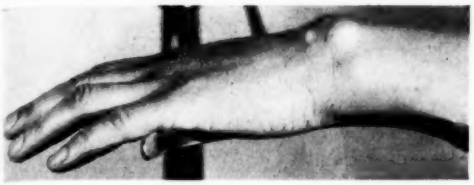

Fig. 1. Case history 164640. A typical multilocular ganglion of the dorsal surface of the wrist of 3 years' duration in a 24-year-old female. It was attached to the capsule of the wrist joint and extensor tendon sheaths.

with the fluid in the joint. The growths are attached to capsules of joints, tendon sheaths, or both. What is left of this connective tissue apparently varies with the amount of degeneration it has undergone.

We believe that the so-called "false ganglia" (those communicating with joints) and a similar cyst which Pick (19) found communicating with the wrist joint postmortem are also evidences of complete degeneration of the capsule of the joint. Operative trauma might also produce such a communication.

The lesion consists essentially of a chief cyst, which may be unilocular or multilocular, surrounded in almost every instance by a group of accessory cavities ranging in size from microscopic up to an equality with the main cavity (Fig. 5). The wall of the main cyst is made up of a dense fibrous tissue resembling that found in the capsule of a joint. There is often a dense, smooth, shiny white membrane lining the lumen. This is simply a condensation of the fibrous tissue of the wall and has no special lining cells.

As a rule the cysts are filled with a thick, sticky, colorless fluid of the consistency of soft jelly (*gélee de pomme*) which is probably

Fig. 3. Case history 83726. A characteristic ganglion of the volar radial region of 4 months' duration in a 26-year-old female.

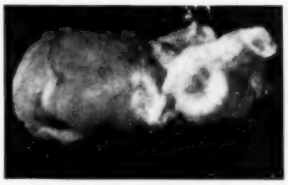

Fig. 2. Case history 164640. Photograph of specimen excised from case illustrated in Figure 1.

of the nature of mucin.[1] Rarely the fluid is described as watery and occasionally it has been tinged yellow, red, or brown by blood pigment.

A striking feature of the microscopic picture is the presence of what seem to be areas of degeneration scattered through the cyst wall (Fig. 7) and in the surrounding

[1]With the addition of acetic acid a cloud appears which does not disappear on further addition of acid, but does when alkali is added in excess. Hydrolysis with concentrated hydrochloric acid liberates a substance which reduces Benedict's solution. The material stains a pale blue in hæmatoxylin and eosin stains and has long stringy strands in it. All of these tests show a behavior similar to that of mucin. Boiling after acidifying gives no coagulum which excludes albumin and globulin. Most of these tests were made by Dr. Louis Bauman.

An attempt was made to learn something about the behavior of mucin in the tissues by transplanting a ganglion beneath the subcutaneous tissue of a dog's back. In a very few days it had disappeared leaving no trace and the attempt was not repeated.

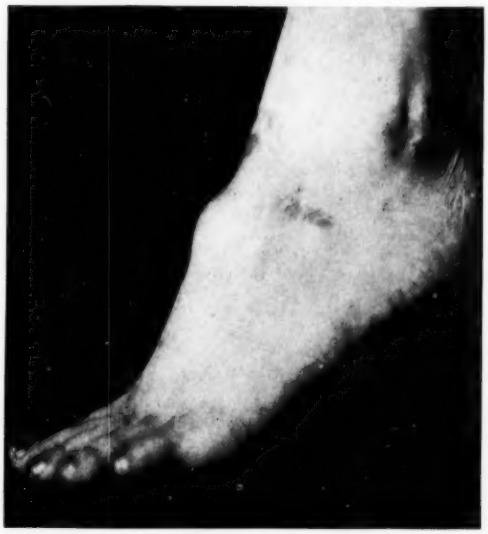

Fig. 4. Case history 97522. Photograph of a ganglion of the dorsal surface of the foot of 3 months' duration in a 12-year-old female. It was aspirated and injected with half strength tincture of iodine. Four years later there was no evidence of re-appearance.

Fig. 5. Case history 120066. Low power photomicrograph of a ganglion. Above is the main cyst cavity surrounded by its dense fibrous wall with remnants of incomplete septa projecting into it. To the right is an accessory cyst cavity. Below is an extensive area of mucinous degeneration with many tiny cavities scattered through it. Between the main cyst cavity and the area of degeneration are two large exceedingly thick-walled veins cut tangentially and showing small slit-like lumens. Frantz, Stout, and Clark (6).

tissues. These areas are soft and of the consistency of myxomatous tumors. In them the collagen fibrils, instead of being broad and thick, are broken up into fine threads and in some places have disappeared entirely. At

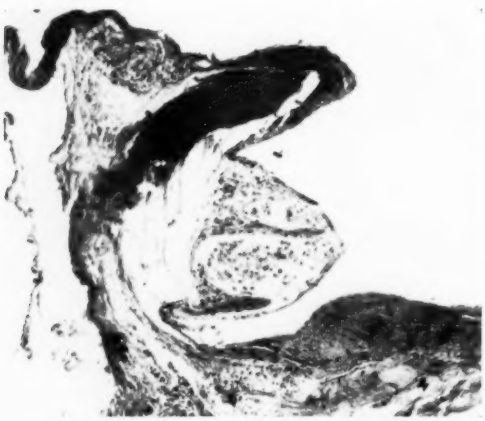

Fig. 7. Case history 51559. Photomicrograph of an area of degeneration in the dense fibrous wall of a ganglion. It should be noted that there are no differentiated cells lining the cyst cavity which lies above and to the right.

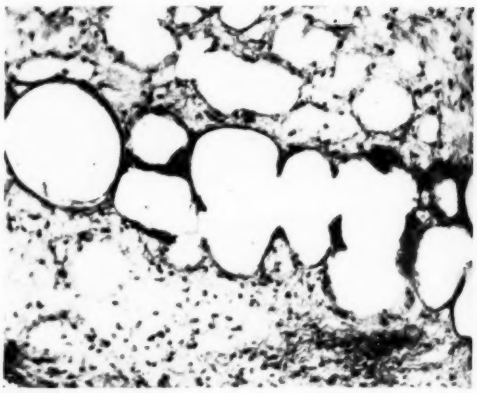

Fig. 6. Case history 120066. Photomicrograph showing a group of cyst cavities in an area of degeneration. The multilocular cavities with the incomplete septa separating the locules suggest that larger cysts are formed by the coalescence of small cavities.

widely spaced irregular intervals throughout this tangled skein are rounded, spindle-shaped or polygonal cells. The cell bodies are sometimes found distended with vacuoles (Fig. 10) and frequently many protoplasmic processes pass out among the surrounding network of collagen fibers (Fig. 9). In these areas are often found large and small rounded spaces in which there are no cells and no fibers. Where two of these cavities are in close approximation they may be incompletely separated from one another by remnants of a disintegrated septum (Fig. 6).

These observations suggest very strongly that there has occurred a mucinous degeneration of the collagen in a number of isolated but closely approximated areas in the dense connective tissue adjacent to a tendon sheath or the capsule of a joint. As the process has advanced, small cyst cavities have been formed and the coalescence of these has resulted in the formation of one or more large cyst cavities filled with mucin. The occasional mitoses that have been observed in these areas and the thickness of the walls of most ganglia suggest that there must have been some cell proliferation in and about these areas. Whether this precedes the degenerative process or is coincidental with it we are not prepared to say. It differs from myxoma, a true fibrous neoplasm associated with mucinous

Fig. 8. Case history 43388. Photomicrograph showing two bundles of nerve fibrils (A) surrounded by thick epineurial sheaths passing through an area of degeneration. To the right of them is a small cyst cavity. The marked vascularity of the dense fibrous tissue about the area of degeneration should be noted. Frantz, Stout, and Clarke (6).

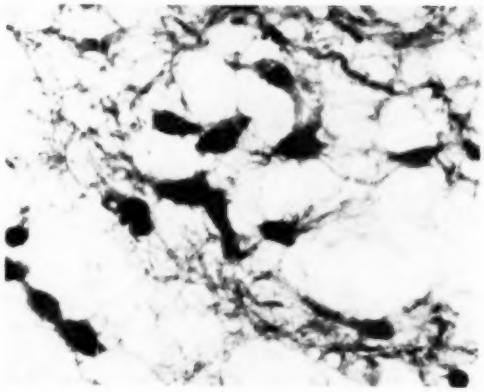

Fig. 9. Case history 120066. High power photomicrograph of cells in an area of degeneration showing the irregularly shaped cells with long protoplasmic processes extending out from them. Many of the intercellular fibers are collagen probably undergoing mucinous degeneration. The intercellular spaces probably contained mucin.

degeneration, both in the multiplicity of foci and in the regular cyst formation. This observation leads one to suspect that the tissue increase is coincidental with the accumulation of the mucinous fluid because of the frequency with which the entire process ceases following its dispersal and absorption or its withdrawal by aspiration.

The walls of the larger cysts are sparsely supplied with capillaries but no more so than the dense capsular tissue of joints. In the looser surrounding tissue there is usually a rather rich vascular supply. With great regularity one finds that the larger vessels have very small lumens due to marked fibrosis of the walls. Even the capillaries are often thickened. Ritschl (20), Thorn (22), and others have suggested that these vascular lesions may have caused a local impairment of nutrition with resultant degeneration. We feel, however, that this hypothesis is inadequate, first, because such vascular lesions are commonly found in the neighborhood of most chronic inflammations where no such mucinous degenerations are found; second, because patent blood-containing capillaries are often found passing through and presumably furnishing nourishment to these areas of degeneration (Fig. 11); and, finally, because the process often ceases following aspiration of the cyst contents, a procedure which can hardly have much effect upon the blood vessels. We feel, as do Payr (18) and Kuettner (13), that the vascular change is probably secondary to or concomitant with the cyst formation.

There is remarkably little evidence of inflammatory cellular infiltration in and around these lesions. The usual finding is the presence of a few mononuclear wandering

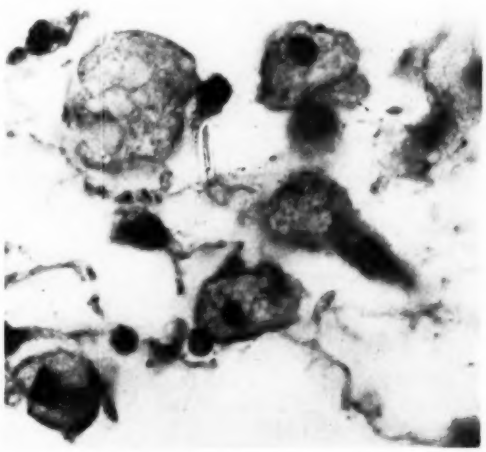

Fig. 10. Case history 13117. A high power photomicrograph showing some cells in an area of degeneration distended with vacuoles containing mucin.

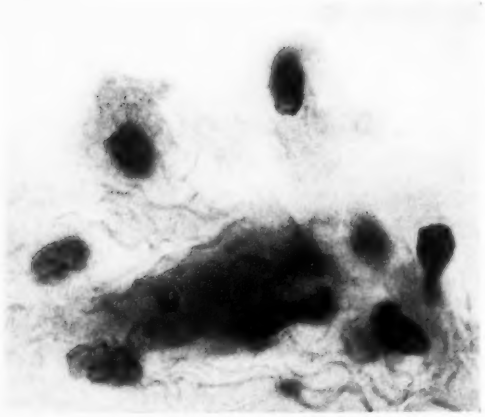

Fig. 11. Case history 143421. Photomicrograph showing a capillary filled with closely packed red blood cells in the center of an area of degeneration. Above, two cells with mucin containing vacuoles can be seen and surrounding the capillary are many frayed and longitudinally split collagen fibers.

cells in the immediate vicinity of some of the smaller vessels. Occasionally, associated with trauma, hæmorrhage, or infection, larger numbers of mononuclear cells and polymorphonuclear leucocytes are found to be present.

It has been stated by some authors that ganglia have been found forming in tendons, periosteum, and nerve sheaths. As we have not observed any associated with tendons or periosteum, we cannot confirm this. In regard to nerves, we have frequently observed bundles of fibers passing through the areas of mucinous degeneration (Fig. 8) and have found them adherent to the radial nerve at the wrist, but, as all of these cysts were in close approximation to a tendon sheath or capsule, we felt that the nerve involvement was a chance one. This close connection with nerves may account for the pain and tenderness which are often associated with some ganglia.

We have not observed nor read of malignant neoplasms arising from ganglia. Spontaneous infection of ganglia occurs very rarely. We have never observed spontaneous rupture of a ganglion through the skin, but one patient stated that his ganglion had ruptured spontaneously through the skin.

TABLE I.—ANALYSIS OF 255 CASES

Age (in years) at which ganglion began	Cases	Per cent
2— 5	7	2.74
6—10	14	5.48
11—20	86	33.73
21—30 (Average of 26 yrs.)	83	32.51
31—40	27	10.57
41—50	18	7.04
51—60	11	4.31
61—70	6	2.35
71—76	3	1.17
Sex		
Female	190	74.50
Male	65	25.49
Occupation		
Housewife	72	28.25
School child	56	21.88
Maid	9	3.52
Miscellaneous	18	46.24
Trauma		
Present	79	30.97
Not present	140	54.91
Questionable	36	14.12
Location		
Dorsum of wrist	175	68.00
Volar surface of wrist	47	17.50
Volar surface of finger	13	5.10
Dorsum of foot	10	3.92
Dorsal surface of finger	3	1.18
Popliteal region	3	1.18
Lateral region of malleolus	2	0.78
Indefinite region	2	0.78
Size (diameter)		
Largest, 6 cm.	...	.....
Smallest, 7 mm	...	.....
Most common, 2 cm	...	.....
Pain		
Present	113	44.32
Not present	110	43.14
Questionable	32	12.53
Tenderness		
Present	73	28.63
Not present	125	48.98
Questionable	57	22.34
Origin of ganglion in 109 operative cases		
Capsule of wrist joint	56	51.40
Extensor tendon sheath	14	12.84
Flexor tendon sheath	9	8.25
Tendon sheath	4	3.65
"Discrete"	3	2.75
Unclassified	23	21.10
Treatment		
Operative	109	42.75
No treatment	81	31.77
Breaking	32	12.55
Aspiration and injection of iodin	16	6.75
Strapping and pressure	7	2.74
Baking and massage	5	1.96
Aspiration and pressure	3	1.18
X-ray	2	0.78

ETIOLOGY

Many authors have discussed direct trauma, continued or sudden, hard or unaccustomed use of joint or tendon, and individual constitutional tendency as causes of ganglia.

TABLE II.—TREATMENT AND LATE RESULTS IN 255 CASES (CARP AND STOUT)

Method of treatment	Cases	Per cent	Cases followed (total—70)	Longest time (mo.)	Shortest time (mo.)	Average time (mo.)	Re-appearance	Dis-appearance	Still present
Operative	109	42.75	35	168	3	28.0	11 (31%)	24 (69%)	..
None	81	31.77	12	60	3	36.5	..	7 (58%)	5 (42%)
Breaking	32	12.55	9	48	4	12.0	2 (22%)	7 (78%)	..
Aspiration, injection, chemical irritant, pressure	16	6.75	8	72	1	55.5	2 (25%)	6 (75%)	....
Strapping and pressure	7	2.74	3	48	1	20.0	..	..	3 (100%)
Baking and massage	5	7.96	1	10	..	..	..	..	1 (100%)
Aspiration and pressure	3	1.18	2	15	6	10.5	2 (100%)	..	..
X-ray	2	0.78	..	..	..	..	..	..	..

It is difficult to conceive of direct trauma to the dorsal surface of the wrist as the primary cause of degeneration of the dorsal carpal ligament, as this ligament is well protected by overlying tendons. Some patients ascribe the appearance of the swelling to a definite trauma. Kuettner (13) found trauma in 20 per cent of his cases. On the other hand, there are many traumata to this region without subsequent formation of ganglia and it is hazardous to stress this as an etiological factor.

The importance of constitutional tendency is difficult to establish. The fact that complete excision of the ganglion has not, as a rule, been followed by a re-appearance is not easily explained.

The preponderance of ganglia in the second, third, and fourth decades in females of slight build is generally a striking observation. The progressive diminution of the number of cases after the fourth decade and their comparative rarity in old age is also striking.

ANATOMY

Those ganglia arising from the capsules of joints are intimately adherent to them, usually by a broad base, so that they can be excised only by sharp dissection. We have not been able to note a definite pedicle. Tendons are usually pushed aside by the cyst which also becomes adherent to tendon sheaths when these are present. On the dorsal surface of the wrist, ganglia may occur on the radial, ulnar, or middle aspect. In most instances, they are found over the articulations between the navicular and lunate bones and the lesser multangular and capitate bones. Laterally they are bounded by the extensor longus pollicis and mesially by the extensor communis digitorum and extensor indicis. The ganglia on the volar aspect of the wrist lie, as a rule, laterally between the tendons of the flexor carpi radialis and supinator longus. Here they are in close relation to the radial artery, and in one of our cases this artery coursed directly through the capsule of the ganglion. On the volar surfaces of the fingers, the ganglia are intimately attached to the flexor tendon sheaths, usually at their bases, and in some instances they are also adherent to the skin.

SYMPTOMS AND SIGNS

The symptoms may be grouped under deformity, function, and pain. The swelling may come on gradually or appear suddenly or the patient may give a history of alternate increase and decrease in its size. Quite often the chief complaint is "a bone out of place" or a "weeping sinew." About half the patients complain also of pain, which may be present only on use of the adjacent joints or may also radiate from the region of the swelling. Encroachment of the cyst on tendons frequently produces a sense of weakness in the fingers or toes to which the tendons go. The swelling may be very large or very small. On

TABLE III.—TREATMENT AND LATE RESULTS IN 702 CASES (NEUMUELLER AND ORATOR)

Method of treatment	Cases followed	Longest time (mo.)	Shortest time (mo.)	Average time (mo.)	Re-appearance	Disappearance
Breaking....	52	?	?	?	23	..
Excision.....	31	?	?	?	1	..
Continuous pressure...	?	?	?	?	..	10
None.....	?	?	?	?	8	..

TABLE IV.—TREATMENT AND LATE RESULTS IN 170 CASES (KUETTNER)

Method of treatment	Cases followed	Longest time (mo.)	Shortest time (mo.)	Average time (mo.)	Re-appearance	Disappearance
					%	%
Puncture and injection...	?	?	?	?	57	..
Breaking....	?	?	?	?	50	..
Subcutaneous incision....	?	?	?	?	36	..
Excision.....	?	?	?	?	30	..
None.....	?	?	?	?	..	16

the dorsal aspect of the wrist and in the popliteal region they are apt to be largest and in two of our cases the swelling was 6 centimeters in diameter. The smallest ganglia occur on the flexor tendon sheaths of the hand where they attain the size of a millet seed or split pea. The swelling may be visibly multilocular (Fig. 1), but most frequently it is rounded, not attached to skin, but most commonly attached to the deeper structures. Some ganglia are almost invisible and very difficult to palpate especially if they have not yet separated tendons. A ganglion on the dorsal surface of the wrist is accentuated by flexion and, *vice versa*, one on the volar surface by extension. Most ganglia are very tense, a few fluctuant, and some vary in consistency. It is safe to predict attachment of a ganglion to the capsule of a joint if the tenderness is marked. Close relationship with a nerve or blood vessel may also cause marked tenderness. However, ganglia, which are attached only to flexor tendon sheaths of the fingers are generally quite tender.

Roentgenograms give no additional information except to show in some instances a shadow in the soft parts.

A differential diagnosis must be made from tuberculosis of the joint or tendon sheath, lipoma, myxoma, sarcoma, fibroma, bursitis, osteoma, and aneurism.

TREATMENT AND PROGNOSIS

We believe that the treatment should be non-operative in all cases except those in which this therapy has failed and in which there are persistent troublesome symptoms or deformity. The foregoing is based on a late follow-up of 70 of our cases. The types of therapy have been noted in the analysis. It is probable that complete operative removal of a ganglion will not be followed by a reappearance. We have reason to believe that in our operative cases in which there was reappearance, the removal of the cyst wall had been incomplete. This indicates the absolute necessity of careful technique under strict asepsis and under a general anæsthetic and the use of a tourniquet in order to produce a bloodless field. Prolongations of the cyst wall must be followed until they are removed completely. Nor should any so-called "pedicle" be tied off. Careful hæmostasis should be insured. In the event of accidental entry into a joint, closure of the capsule over the opening is not necessary. A firm bandage over the wound tends to minimize the chance of formation of a hæmatoma from an oozing capsule. Infection will not only cause potential danger from spread along fascial planes or tendon sheaths but will prolong the postoperative course and produce an ugly scar.

Cases receiving no treatment occasionally give a definite history of spontaneous disappearance of the ganglion. This is corroborated by physical examination. Out of 12 cases followed in this group 7 ganglia disappeared. We have the assurance of two doctors who had ganglia of the dorsal surfaces of the wrists that these disappeared spontaneously. Some years ago one of us (L. C.)

observed a ganglion on the ulnar volar aspect of the wrist which disappeared in about 3 years. There are several possibilities that might account for this phenomenon, for instance, the ganglion might be ruptured by a trauma which was not noticed or degeneration might cease with subsequent absorption of the mucin.

Ganglia which are broken by gradual pressure of the fingers or a sudden blow may never re-appear, as shown by 7 of the 9 cases followed in this group. As a rule, those ganglia connected only with tendon sheaths are easily broken. It may be impossible, however, to break those which subsequently prove to be attached to the capsule of a joint, which have a thick connective tissue wall, and which are well protected by soft parts. It is this type which is almost always tender, probably from pressure on the nerves and blood vessels of the capsule. The expressed contents of the ganglion are probably absorbed and there is subsequent agglutination of the cyst walls. There are others, on the contrary, which refill the cyst cavity with mucin, thus causing a re-appearance of the ganglion.

Aspiration of the contents of a ganglion with injection of an irritant, such as tincture of iodine or carbolic acid, gave good results in 6 of the 8 followed cases. This treatment should be followed by a pressure bandage and is especially indicated in those ganglia which cannot be broken and are troublesome.

Strapping, baking, and massage probably produce the same type of trauma as pressure and are not to be recommended because other methods of treatment are more effective.

SUMMARY

1. We believe that ganglia are cysts resulting from mucinous degeneration of connective tissue. They occur generally in or are attached to capsules of joints or tendon sheaths but do not communicate primarily with joints or sheath spaces.

2. The degeneration proceeds with fibrillation of the collagen fibers and accumulation of mucin both within the cells and in the intercellular spaces. This results finally in the disappearance of cells and fibers in a number of adjacent areas. These embryonic cysts coalesce and lead to the formation of larger cavities. The cause of this degeneration still remains obscure but it is probably not due to any lack of vascular supply. Although there is evidence of cell proliferation we are not of the opinion that ganglia are neoplasms.

3. They occur most frequently about the wrist joint, volar surfaces of fingers, dorsum of foot, and popliteal region. Ganglia are most frequently found in females of slight build in the second, third, and fourth decades. We are not convinced that trauma plays a major rôle in their production.

4. The chief symptoms and signs are swelling, pain, interference with function, and tenderness.

5. A differential diagnosis must be made from tuberculosis of the joint or tendon sheath, lipoma, myxoma, fibroma, osteoma, sarcoma, bursitis, and aneurism.

6. Late results after various therapeutic measures have convinced us of the advisability of non-operative treatment. So many ganglia disappear spontaneously and after breaking and pressure, aspiration and pressure, or aspiration with injection of a chemical irritant and pressure that operative therapy should be recommended only when non-operative treatment has failed and when there are *persistent* troublesome symptoms, signs, or deformity. Careful, complete excision of ganglia under strict asepsis and with a bloodless field will probably not be followed by re-appearances.

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ULCER CRURIS: THE ETIOLOGY, PATHOGENESIS, AND TREATMENT[1]

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ULCER cruris or the more commonly known varicose ulcer may be one of the most severe and disabling conditions of the lower extremity. Individuals so afflicted are truly "victims" and even though healing is successful they must endure their disability for the rest of their lives with a fear of a recurrence of the ulceration.

The etiology is now very generally accepted to be a trophoneurotic disturbance and condition resulting secondarily to the development of varicose veins. Since the varicosed condition of the veins with the resultant stagnation of fluid in the tissues is the basic factor producing the ulcerations, we must first discuss the etiology of varicose veins.

The normal flow of blood from the foot is upward through the deep set of veins located among the muscles of the leg and the superficial veins in the fatty tissue just under the skin. The flow upward is accelerated (1) by the contraction of the muscles of the calf while walking and (2) by the aspiratory effect of respiration. The latter has often been denied, yet it can be seen and has been experimentally proved. This aspiration is in two phases: (a) from the upper extremity during inspiration and (b) from the lower extremity during expiration. Inspiration increases the negative pressure in the chest yet increases the positive pressure in the abdomen and vessels below the diaphragm. Expiration, with the diaphragm rising, produces an aspiration with a negative pressure below the diaphragm, assisting the upward flow of blood in the veins of the extremities. This back pressure during inspiration, acting on the valves in the femoral and saphenous veins at the saphenofemoral junction, aids the reflux flow of blood in the superficial set of veins.

Back pressure is further increased by the intra-abdominal pressure from heavy lifting. It is increased by pregnancy with its mechanical obstruction as well as the great increase in blood volume supplied to the iliac vein by the greater vascularity of the uterus (Kownatzki and Loehr).

In addition to these causative factors, we have conflicting theories regarding other factors. Sicard of the University of Paris believes that the condition can best be explained by a lack or absence of the endocrine functions of the ovary. Kashamura, the Japanese surgeon, believes that they are entirely due to the loss of the neuromuscular tone of the vein wall. Von Meisen of Copenhagen believes varicose veins are associated with a general weakness of the connective tissue structure of the body and accompany such pathological states as flat feet, enteroptosis, varicocele, etc. Schambacher and Lederhose believe that there is a congenital weakness of the vein walls. Bregman believes that there is an angiosclerosis and phlebosclerosis similar to that of arteriosclerosis as the primary factor. Zinser and Phillip both believe that syphilis plays a factor in a larger percentage of the cases than we have thought. Some authorities, notably Fischer, Nobl, Renzi, Hesse, and Schaak, believe that the condition is best explained on the theory and basis of a former infection involving the vein wall and probably embolic in nature. This would account for the multiple segments of veins involved better than any other explanation. I am firmly convinced that the great majority of cases can best be explained by the infection theory, with heredity as a predisposing factor.

As a result of various causes the veins lose their power of carrying the venous blood to the heart and become dilated and filled with stagnate blood. Sooner or later the difference in pressure between the blood in the veins and the fluid in the tissues is equalized. Then by the process of stasis the tissues become waterlogged and their resistance to infection or trauma becomes lowered because of impaired nutrition. As a result an ideal condition for the development of the varicose ulcer is produced. Figure 1 is self explanatory of this condition as it shows complete loss of valve function in superficial and communicating veins and the association of venous blood with tissue saturation.

[1]Read before the Staff of the Norwegian Deaconess Hospital, April 19, 1928.

The immediate cause of the tissue breakdown is often trivial. It may be embolic and due to infected teeth, tonsils, hæmorrhoids, etc., or, as frequently happens, it may result from light trauma and terminate in local necrosis. If not cared for the affected veins may increase in size and number, the congestion may increase, the ulcer may penetrate deeper, and may result in a painful periostitis of the tibia. However, the process may be limited and cured by prompt, efficient treatment, although the ulcer cycle always causes much damage to the circulation and nutrition of the tissues and leaves the tissues far more susceptible to ulceration. Ultimately, following years of ulceration and healing, the tissues become so indurated that a continuous potential state of gangrene exists and ulceration can be prevented only with the help of external support.

PATHOLOGY

The actual ulceration begins with a gangrene and separation of the superficial layers of the skin. At times the area takes on the typical appearance of a carbuncle, while in other cases as a result of a long-standing condition the ulceration extends through all of the dermal layers. In some cases the whole lower leg has the appearance of an extensive, far advanced, weeping eczema.

Microscopic sections through the ulceration demonstrate that the pathology is largely in the skin and that there is only an inflammatory reaction of the tissue beneath.

Bacteriological examination of the ulcers has proved that there is no constant organism that may be held as a specific cause. The staphylococcus and streptococcus are found in all cases and are usually associated with other organisms. In no instance, regardless of the severity of the case, has the gas bacillus or bacillus of gangrene been found. Professor Gabor Nobl states that he does not believe that there is any relation between the type of infection or bacteria in the ulcerating area and the slowness or rapidity with which the ulcer heals. His opinion was confirmed by the extensive work of Lowenfeld on the *Bacteriology of Varicose Ulcers*, which shows that those ulcers which heal most rapidly often contain the most bacteria. My experience confirms this opinion.

DIFFERENTIAL DIAGNOSIS

In discussing the differential diagnosis of varicose ulcers we must consider the syphilitic, the tuberculous, the rodent (malignant), and the rarer forms of ulcerating conditions of which the most common would be actinomycosis.

1. *Varicose ulcers* are by far the most common ulcerating condition of the lower extremities and are of all sizes, shapes, and conditions. Associated with the ulcer there is usually a well marked area of inflammatory reaction, which at times will spread for several inches beyond the open ulcer. The ulcer as well as the surrounding tissues may be very tender. The edges are usually sloping in appearance and the base is ordinarily covered with large, coarse granulations and a grayish exudate. The discharge may be very profuse. As already stated the dilated varicose veins with their reflux flow and accompanying congestion are accepted as being the cause of the varicose ulcer. One can nearly always find these large venous channels about the ulcerating area. Sometimes the veins lead directly into and under the ulcer and in these cases a very positive diagnosis can be made (Figs. 2 to 7, inclusive).

2. *The syphilitic ulcer* usually has punched out, sharply defined edges, which at times are raised. It is ordinarily deeper than ulcers arising from other causes. The base is dark red and has large granulations, which may be unusually large in the larger ulcers and may bleed very readily. Much serum exudes from the surface but this does not give the impression of being pus. Luetic ulcers may assume any shape or condition. In addition to the clinical appearance, a positive Wassermann is present and often a history of the original infection is obtained.

3. *The tuberculous ulcer* is uncommon on the lower extremities. The edges are usually undermined. Some authors state it has a tendency to progress with an irregular border outline giving the impression at times of a half circle, but this is not a tuberculosis characteristic. The base is seldom red and granu-

lating as in the luetic ulcer, but more frequently is covered with a grayish necrotic exudate. It is thought that the tuberculous ulcer is always secondary to tuberculosis elsewhere. An active tuberculosis would of course be a definite diagnostic sign.

4. *The rodent or malignant ulcers* are infrequent on the lower extremities although common elsewhere, they are found in older patients and do not have the local inflammatory reaction which is seen with varicose ulcers. There would be no varicose veins except as a coincidence and there would be no response to the usual treatment. With a negative Wassermann, no symptoms or signs of tuberculosis, and with no response to the usual ulcer treatment, a biopsy should be made to confirm the diagnosis.

5. *Trophic ulcers* can usually be diagnosed without difficulty after consideration of the clinical history of the case.

6. *The actinomycotic* ulcer starts as a nodule, subsequently breaking down, leaving a necrotic base with scattered yellowish nodules. This type of ulcer is very rare and is seldom seen except in hide-handlers, etc. The diagnosis would be suspected when cure had resisted all treatment. Curettings should be made from the ulcer base with examinations for the ray fungus.

TREATMENT

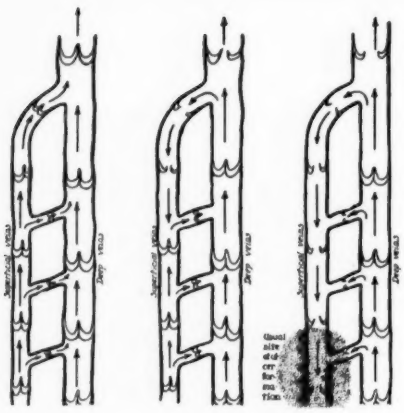
The results of treatment of ulcer cruris have always been unsatisfactory. Ointments and lotions are legion and include those used by the Indian healers, the miracle men, the professional quacks, and those employed today by the profession. Silver nitrate is by far the most efficient of all, although any ointment supported by a bandage may prove useful. The Unna cast is, I believe, the most efficient.

Boynton's adhesive strapping for support directly over the ulcer has many advocates and is often efficient, due to its support of and pressure on the granulating surface.

Pondorff favors the vaccine treatment. It is believed that an autovaccine made from the organisms infecting the ulcer area is of much value. La de Gaetano and several other authorities on the subject believe that the results obtained following the use of Boynton's adhesive strapping or with the Unna cast are due in large measure to the softening of the tissues by the continued local bathing by the secretions of the ulcer with a secondary reabsorption and autovaccination from the bacteria present. It is probable that such is actually the case and that this is a large factor in the good recovery obtained in some of the extreme cases.

In the past the surgeon has felt that operation is necessary and has devised all sorts of procedures, having as their goal the correction of the defective circulation. A common operation is the Schede multiple circular incision. The surgeon here attempts to cut and ligate all vessels of the offending and superficial group of veins. Babcock advised stripping the main vein with his specially devised stripper. Charles Mayo improved on this and today his is a popular method and has frequently given good results. Some raise the fat from the deep fascia from one Schede incision to another thus hoping to break all the communicating veins. This is efficient if there is only a plexus present, but if the condition is extensive and scattered it is almost useless. Other surgeons have made long incisions from groin to ankle removing the long saphenous with its side branches, but an unsightly scar results and recurrences have been frequent. Some have made circular incisions about the ulcer hoping to break all venous supply. These methods entail preliminary bed rest with elevation for the badly infected cases. Operation is contra-indicated until the condition is brought under control.

The injection of sclerosing solutions is the most modern and efficient method of treatment when the veins are the chief cause of the ulcers. It accomplishes better and more thorough results than the operative treatment and has the added advantage of not necessitating hospitalization, anæsthetization, bed rest, loss of time from work, risk of infection, and extensive operative incisions. When the proper technique is employed, no disfiguring scars follow this treatment, and there is less danger of embolus than from operative procedures. The injection treatment can be started at once in cases of badly infected ulcers and the results are thereby hastened.



a. *b.* *c.*

Fig. 1. *a*, Nominal flow in superficial and deep veins; *b*, beginning reflex in superficial veins; *c*, complete loss of valve function in superficial and communicating veins.

The technique of the injection is simple and follows the method of Linser, Sicard, Nobl, and von Meisen. I have added the use of a tourniquet so that temporarily the solution will be retained locally and the sclerosing effect will be insured. I use a 20 per cent salt solution for all extensive cases, the 60 per cent and 76 per cent calorose for the isolated varix which is often left after the use of the salt injection or in cases in which there is one long vein with a distinct positive Trendelenburg, and the 30 per cent and 40 per cent sodium salicylate in the occasional case that does not respond to salt or calorose. I have used 1 per cent mercuric chloride in 3 cases during the past year, because the veins resisted the sclerosing effect of other solutions. For each solution there is a definite indication and a definite characteristic reaction, some reactions being more extensive than others. The most important point in the technique is that the injection *must always be within* the lumen of the vein. This is absolutely imperative in order to avoid sloughs and complications. With the proper technique and proper choice of solution, the ideal results are obtained (Figs. 8, 9, 10).

When the affected veins have been destroyed and the circulation has been corrected, the ulcer heals quickly under routine treatment. This is accomplished by the method of Rodolfo Klapp of the Clinic of Berlin with the additional use of a large rubber sponge as advised by Professor Nobl. In the case of large ulcers, skin grafts are made at the proper time. The rubber sponge aids in giving the needed support to the leg and by elastic compression forces the excess fluid from the tissues, at the same time removing the continued stagnation of fluid in the ulcer area. The method now used is as follows:

1. Inject and sclerose all veins as fast as they can be found.
2. Apply silver nitrate locally, the strength of the solution depending on the type of granulations present.
3. Cut a good grade of rubber bath sponge so as to cover 1 inch beyond the edge of the ulcer.
4. Cover the ulcer with gauze, fluffed for better absorption.
5. Apply the cut rubber sponge over the ulcer.
6. Cover all with two layers of glazed cotton wadding, which is impervious to the discharge and helps keep the bandage clean.
7. Bandage the leg with a good grade of cotton elastic bandage, similar to the "Ace," and preferably 4 inches in width. This is put on from knee to toes and as tightly as it can be wrapped.
8. Change dressings every 2 to 3 days as needed for comfort and care of the discharge.
9. Continue the rubber sponge pressure until the ulcer has completely healed.
10. At the proper time, judicious use of skin grafting will very materially shorten the period of healing. This, however, should not be done until after careful and complete sclerosing of all the offending veins and complete elimination of the lymphangitis and extensive tissue infection about the ulcer have been effected. The ulcer bed should be carefully prepared as for any skin graft.
11. In all cases as soon as the ulcers have healed, put on an Unna cast for continued support. This is *most* essential in cases in which skin grafts have been made and must be applied before the patient leaves the bed. Change this cast every 2 weeks at first and then every 3 to 4 weeks. In all extensive cases this must be continued for a long time either

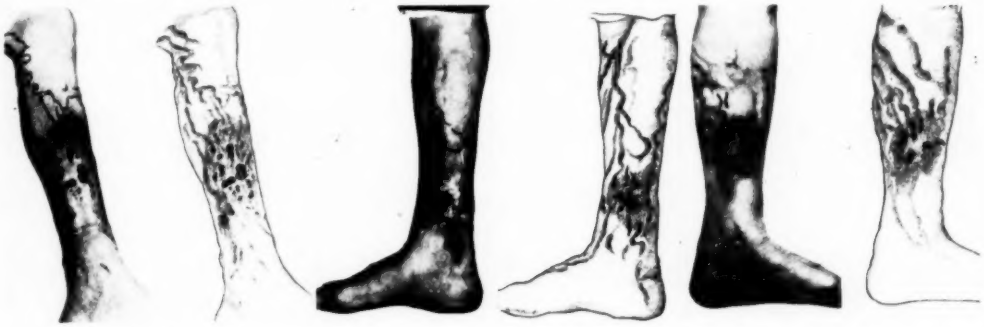


Fig. 2. Fig. 3. Fig. 4.

Fig. 5. Fig. 6. Fig. 7.

Figs. 2 to 7. Showing the intimate relation of veins to the ulcer. In Fig. 6 is shown a fungus infection of eczematoid ringworm on the foot and leg which often complicates the ulceration.

by casts, bandage, or the elastic and rubber stockings. In some cases the patient needs this support the rest of his life in order to avoid a recurrence.

Many men have associated calcium imbalance with ulcer formation, but so far attempts to correct this have failed. I believe that the use of the average parathyroid extract by mouth is useless. Of late I have been using paroiden hypodermically twice a day. This is thought to be the active hormone of the parathyroid gland prepared according to the technique of Dr. Adolph Hanson of Faribault, Minnesota. The cases as yet are too few to report, but blood calcium checks show a marked increase of calcium content under its use and I feel that the cases have responded more rapidly than have cases in which it has not been employed.

COMPLICATIONS

1. *Complications associated with the ulcerating condition itself.* a. The most common complication associated with varicose ulcers aside from the coincident phlebitis and lymphangitis locally is a pruritis which at times extends over the whole lower leg. This at times is very resistant to treatment and frequently recurs. It is best cared for by two applications each day of Burrough's solution diluted 1 to 10. This is a solution of aluminum acetate plus a small amount of acetic acid. Some advise the use of the aluminum subacetate in an 8 per cent solution and then diluted 1 ounce with 500 cubic centimeters of water. This is applied in the form of continuous wet packs.

b. A fungus infection similar to what Strickler calls eczematoid ringworm and caused by the epidermophyton fungus. This

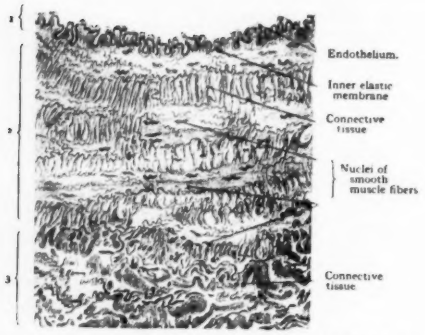


Fig. 8. Normal vein. (From Stoehr-Lewis' *Histology*).

begins in the tough cornified skin near the sole of the foot and between the toes. At times the whole skin will form large, very tender, painful blebs filled with a translucent fluid. In extreme cases the tough skin becomes whitened and macerated and will peel off in large areas leaving a secondary infected base. This condition is also best treated by the Burrough's solution. At times it is very resistant and must be treated persistently and stringently with some ointment such as Whitfield's ointment. This is a preparation of salicylic acid and benzoic acid and has a marked keratolytic effect. Recurrences are common.

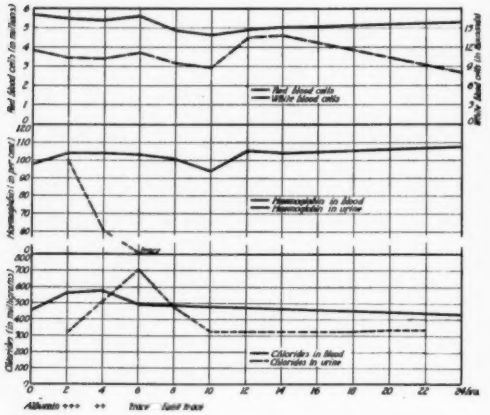


Fig. 10. Composite graph showing the results on the blood and urine following 20 per cent sodium chloride injection. The urine hæmoglobin is due to the breaking up of the red blood cells (hæmoglobinuria and not hæmaturia).

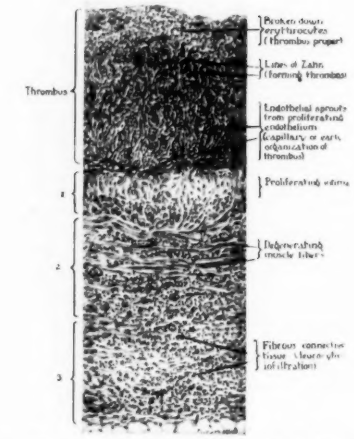

Thrombus
Broken down erythrocytes (thrombus proper)
Lines of Zahn (forming thrombus)
Endothelial sprouts from proliferating endothelium (capillary or early organization of thrombus)
Proliferating veins
Degenerating muscle fibers
Fibrous connective tissue (leucocytic infiltration)

Fig. 9. Treated vein showing leucocytic infiltration with beginning organization of the thrombus following 20 per cent sodium chloride injection.

2. *Complications associated with the injection treatment.* a. If perivascular injections are carelessly made a slough will occur, especially when the salt, the sodium salicylate, or the bichloride solution is used. It is not so constant or severe with the calorose of Nobl or

Fig. 11. (left) M. T. Varicose veins of both legs. October 21, 1927.

Fig. 12. Same patient after treatment; ulcer healed, December 30, 1927.

Fig. 13

Fig. 14.

Fig. 15

Figs. 13 and 14. Mrs. C. Showing condition before and after treatment.

Fig. 15. Mr. L. W. Showing condition before and after treatment.

any of the sugar solutions. If a perivenous or extravenous injection has been made, the first and immediate sensation will be a severe burning at the point of injection. Three or 4 minutes later a definite circumscribed *blanched patch* will appear. Within 10 or 15 minutes this patch assumes very definitely, circumscribed *bluish gray* discoloration. This is absolutely pathognomonic of an extravenous infiltration of the salt solution. If the infiltration has been made more deeply this sign will not appear until later and the burning sensation must be considered sufficient evidence to institute corrective treatment. If this is allowed to go untreated for 24 hours this patch will have assumed a bluish black discoloration with the formation of a large vesicle over the entire area. Following this, there results a dry gangrene which terminates in a slowly healing ulcer. Extensive infiltration of the area with normal saline at the first indication of this sign so as to care for the excess salt

Fig. 16

Fig. 17

Fig. 18

Fig. 19

Fig. 20

Fig. 21

Fig. 22

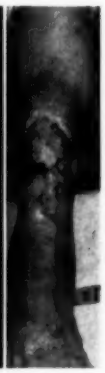


Fig. 23

Fig. 16. John D. Varicose veins and ulcer before treatment, December 2, 1927.

Fig. 17. John D. Varicose ulcer after treatment, January 30, 1928.

Figs. 18 and 19. Mr. A. W. Varicose ulcers, and healed.

Fig. 20. Frank P. Varicose ulcers before treatment, August 24, 1927.

Fig. 21. Frank P. Varicose veins and ulcers after treatment, January 31, 1928.

Fig. 22. Frank S. Varicose ulcer before treatment, November 28, 1927.

Fig. 23. Frank S. Varicose ulcer after treatment by means of vein injection and secondary skin graft, January 31, 1928.

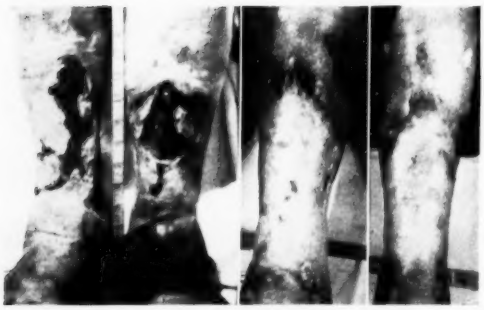


Fig. 24. (left) Sam R. Varicose ulcers before treatment.
Fig. 25. Sam R. Varicose ulcers healed following injection treatment of veins and secondary skin graft.

injected, will avoid the slough and eliminate a very distressing complication which with proper technique should not occur. This is a positive, characteristic condition resulting from a perivascular injection of 20 per cent salt solution and is preventable by an extensive infiltration of normal saline in the involved area. Sterile water has been employed for this condition but gives greater pain and a more extensive reaction during the following 48 hours. A similar reaction develops following a perivenous injection of sodium salicylate or bichloride of mercury. The injection of normal saline, however, does not prevent the development of the slough and gangrene when these solutions are used. When a sloughing, gangrenous area does develop, it is best treated by surgical removal 24 hours following the injection. The tissues are then brought together by an immediate closure and primary suture. The edges should be re-enforced both by suture and adhesive strapping. This procedure, however, should be done under the most meticulous aseptic conditions. I attempted this in one case at the dispensary where we were not prepared to do major surgery and unfortunately a streptococcic viridans infection resulted and later developed into a streptococcic septicæmia followed by death of the patient.

b. Ascending chemical phlebitis at times occurs following injection. I believe this can be explained by the fact that the communicating valves function normally and the reaction of the injected tissues merely proceeds up the saphenous vein to the saphenofemoral junction, similar to the closed end of a water pipe. However, this is exactly what I wish to have occur and the condition no longer causes any concern. If it were an *infectious* thrombophlebitis, then I would worry but as long as I feel that my technique has been perfect and no infection has occurred I am happy to have this finding. When infectious thrombophlebitis does occur, however, the thigh should be supported by strappings of 4 inch strips of adhesive so as to make the patient more comfortable and to help quiet the reaction.

c. True staphylococcus infection with abscess formation at the site of the injection and in the large loops may occur as the result of inefficient sterilization at the site of injection or extensive infection through the tissues from a sloughing ulcer. The two latter complications, however, can be avoided and with the proper decision and technique at the time of the operation should not occur. These infections are very tender and must be opened and drained. Large, hot, wet packs applied to the infected area quiet the painful condition quickly.

This report is based on the care and treatment of 348 cases of varicose veins of which 65 have had ulcerating complications.

SUMMARY AND CONCLUSIONS

1. Ulcer cruris is the end-result of the trophoneurotic disturbance in the leg and foot resultant from the stagnation of blood serum in the tissues secondary to varicose veins.

2. The attempt to cure the ulcer first and the veins second is wrong both in theory and practice.

3. The varicose veins are obliterated far better by the injection treatment than by operation.

4. The supportive bandage for the affected extremity with the rubber sponge pressure over the ulceration is the oldest and yet the *most efficient* treatment of the present day.

5. Judicious employment of the skin graft at the proper time greatly shortens the period of healing.

6. All the long standing cases with extensive involvement *must* have continued support for long periods of time to avoid recurrence.

7. The duration and extent of the support must be decided in each individual case.

8. Finally, by the use of the described technique, all varicose ulcers can be healed and kept healed. If they cannot, it means that the operator has not been keen enough to locate the vein which causes the condition and which is often under the ulcer bed or that he has been negligent in giving the extremity the necessary lasting support.

I wish to thank Dr. Louis Dunn for his many valuable and helpful criticisms in the preparation of this article.

I also wish to acknowledge the valuable assistance of Dr. Carl O. Rice of the Out-Patient Department of the Minneapolis General Hospital, where most of this work has been done.

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ACUTE THYROIDITIS

A Study of Sixty-Seven Cases

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ACUTE thyroiditis with or without abscess formation occurs commonly enough to warrant careful study so that its presence may be diagnosed and proper treatment instituted. Although it is regarded as a rare occurrence by many authors, I have found over 200 cases reported in the literature. Robertson (33) in 1911 reported 96 cases, Hagenbuch (16) in 1921 reported 43 cases, and I have selected 67 out of over 80 cases which have occurred or have been reported during the last decade. Furthermore, many of our clinicians do not find time to record their experiences in literature, so that the tendency is for only a minor proportion of cases of any disease to be published. If this be true acute thyroiditis is not as rare a malady as the medical profession has been wont to believe.

My attention was first drawn to this disease when I was called upon to treat the following case. I report the matter here in detail because it has many interesting features which will be discussed later in this paper and because it is only fair to future students that concise but accurate case reports be given, so that those wishing to accumulate data can have material with which to work.

The patient was a female, aged 77 years, who complained of a painful swelling in the neck. For many years she had had a "small lump" in the anterior part of the neck, about in the midline region of the thyroid isthmus. This had not caused symptoms until 5 days before admission to the hospital, when it began to enlarge and become painful. The swelling spread to the right side of the neck and the pain radiated back to the ear. Turpentine poultices were applied but did not give relief. The swelling became more marked but there was no interference with respiration or deglutition, no cough, and no hoarseness. There were no symptoms of hyperthyroidism or hypothyroidism. Two weeks before admission the patient had had a head cold and pharyngitis. Otherwise, the cardiorespiratory history was negative. The gastro-intestinal history was also negative. The patient had suffered from frequency and nocturia for some time, but there was no burning, hæmaturia, or pyuria. She complained of polydipsia. The family history was negative for thyroid disturbance.

Physical examination revealed a poorly nourished, elderly woman with a red swelling, 5 centimeters in diameter, low down in the neck, anterior in the midline. The tumor was slightly tender and tense and gave a sensation of fluctuation. The process seemed to extend into both lobes of the thyroid gland, particularly the right lobe. There was posterior displacement of the large vessels on the right side. Swallowing was easy and painless and caused the swelling to move anteriorly but not up and down. There was no exophthalmos. Examination of the chest and abdomen was negative. There was no deformity of the extremities, no tremor of the hands, no lesion of the skin, no bone tenderness. The reflexes were normal. The patient's temperature was 99.8 degrees F., pulse 92, and respiration 26. The blood count showed 4,050,000 red blood cells, 73 per cent hæmoglobin, 18,000 leucocytes, and 87 per cent polymorphonuclears. The urinalysis showed a heavy cloud of sugar, no acetone and diacetic acid, 232.6 milligrams per cent blood sugar, 21.7 milligrams per cent blood urea. The basal metabolism was plus 31.

A diagnosis of acute thyroiditis with suppuration and diabetes was made.

An ice cap was applied for the night. In the morning the patient had severe pain, dyspnœa, and a whistling respiration and was coughing up small amounts of bloody mucus. There was pain on swallowing.

Operation under novocain local anæsthesia was performed at once. A small transverse incision was made over the swelling in the midline. After the skin and subcutaneous tissues had been opened an exploratory puncture was made and a thin serosanguinous fluid was obtained. The transverse incision was then extended, the anterior plane of the deep fascia was split longitudinally, and the sternothyroid and sternohyoid muscles were retracted laterally, exposing an abscess wall. This was opened and a quantity of blood serum burst forth under pressure, followed by thick yellow pus. The abscess cavity was found to extend out to the deep vessels on either side. One rubber drain was inserted. Culture showed the presence of staphylococcus aureus.

The convalescence was long and stormy. The diabetic condition was hard to control in spite of the fact that the wound was draining freely. One week after the operation the patient developed an erysipelas of the face, the process apparently starting near the draining sinus and extending up

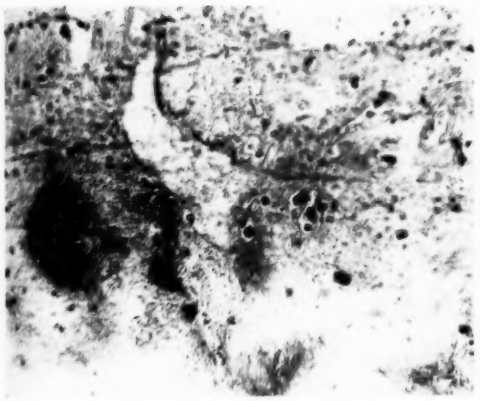

Fig. 1. Tissue removed at operation showing necrosis of glandular tissue with some colloid still present in the degenerated acini.

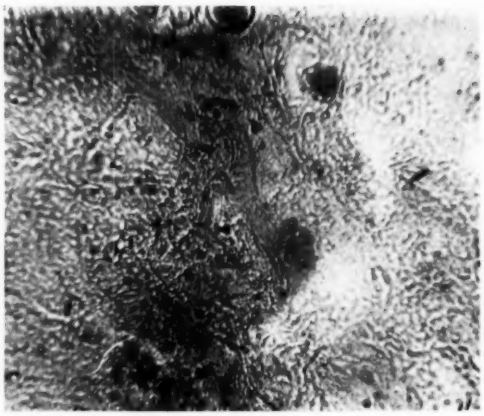

Fig. 2. Photomicrograph of the diseased thyroid tissue removed at operation. The necrosis of the tissue is so marked that only the presence of colloid makes a diagnosis possible. High power.

over the nose and cheeks. The sinus drained a great deal of pus. Ten days later the erysipelas had cleared up, the sinus was still draining pus, and the diabetic condition was fairly well under control. Two days later, however, the patient developed a chill and the temperature rose to 103 degrees. A bloody diarrhœa started and lasted for 2 days. The patient complained of pain in the left knee over the suprapatellar bursal region. This bursa became red and swollen and aspiration revealed pus due to a staphylococcus aureus infection. The bursa was incised widely. Two days later the patient developed pain in the knee joint. As the joint was red and swollen and aspiration yielded pus, an opening was made on either side under gas anæsthesia and a large quantity of thick pus was evacuated. No drainage was introduced. Willems' method of active mobilization was pursued since there was no bone pathology. The joint drained freely but a week later an infrapatellar bursitis developed and was treated by free incision. The infection spread along the patellar tendon into the tibia and an osteomyelitis developed. Amputation was advised but the patient refused to permit it. Blood transfusions were given so as to build up the patient's resistance. The osteomyelitis finally spread into the femur and the patient gradually became weaker and died 3 months after the occurrence of the first attack of thyroiditis.

An autopsy was performed and the thyroid gland removed. It was found that the suppuration had occurred in an adenoma with the pus burrowing either way, so that it lifted the capsule from the right and left lobe. The remaining thyroid gland was filled with adenomata and showed signs of recent inflammation. There was an osteomyelitis of the tibia, fibula, and femur, and a suppurative arthritis with destruction of the right knee joint. Death was due to toxæmia and exhaustion.

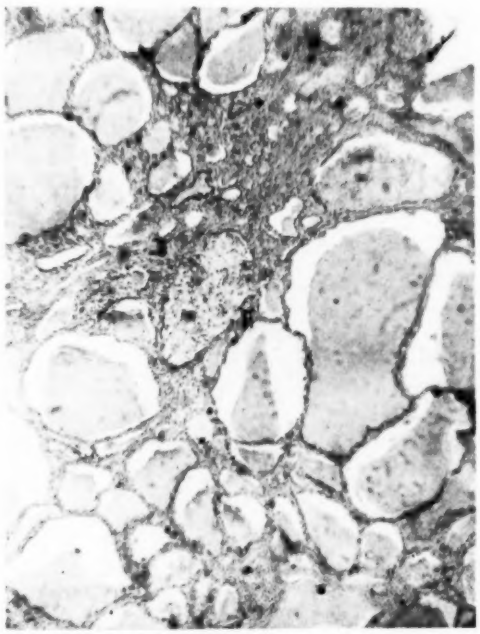

Fig. 3. Thyroid tissue showing acute inflammation. There is dilatation of the capillaries, polymorphonuclear infiltration of the interstitial tissues and the acini, hæmorrhage into the interstitial tissues and acini, coagulation of the colloid, and all types of cell pathology ranging from cloudy swelling to complete necrosis.

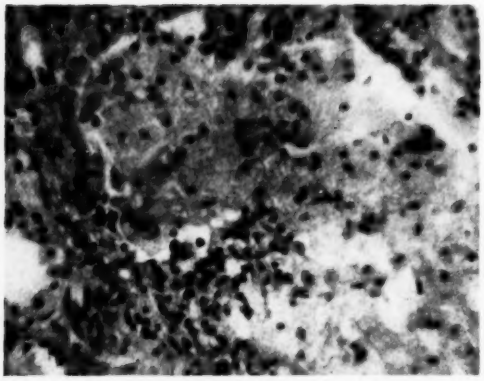

Fig. 4. Area *A* from Figure 3, under high power, showing an acinus into which there has been hæmorrhage and polymorphonuclear and round cell infiltration. The colloid has been replaced by a granular precipitate. As may be observed many of the acinal cells have become completely separated from the basement membrane.

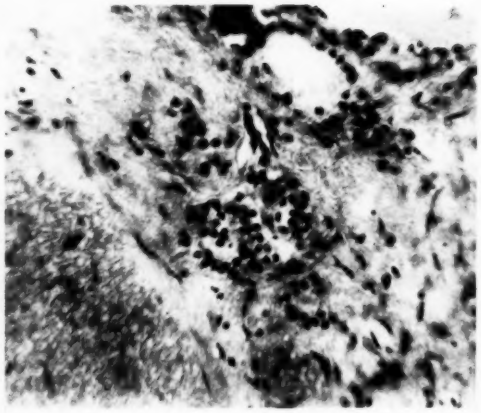

Fig. 5. Area *B* from Figure 3, under high power, showing dilatation of the blood vessels with hæmorrhage and polymorphonuclear and round cell infiltration of the interstitial tissues. There is some fibroblastic and angioblastic proliferation.

ANATOMICAL FACTORS

Anatomically the thyroid gland has certain characteristics which render it resistant to infection. It is a deep seated gland well protected against external injury by heavy fasciæ and muscles. It has no duct along which infection may travel to reach the parenchymatous structure. Persistence of the thyroglossal duct or duct of His leading from the pyramidal lobe to the foramen cæcum does have a direct communication with the pharynx. Meeker (28) has reported a case of infection through a persistent duct Stein (37) has reported a case of abscess of the pyramidal lobe following an upper respiratory infection. This is probably due to the spreading of infection along a persistent thyroglossal duct.

The gland has a heavy capsule formed by fusion of the superficial layer and the pretracheal layer of the deep fascia. It is overlaid by the sternothyroid, sternohyoid, and platysma muscles anteriorly and by the sternocleidal muscles on either side. This deep fascia tends to protect the thyroid from invasion by infection in the contiguous structures, the infection being confined to its facial compartment and traveling up and down but not through these fibrous columns. The heavy overlying fasciæ and muscles tend to make early enlargements of the thyroid and fluctuation in the thyroid difficult to ascertain.

The rich blood supply of the gland is provided by the comparatively large superior and inferior thyroid arteries. Venous drainage through the superior, middle, and inferior veins is free. The vascular arrangement in the gland itself consists entirely of an intricate meshwork of minute capillaries supported in a fine fiber elastic stroma. The lymph drainage is unusually free and, according to Williamson (47), is provided by a specialized anastomotic arrangement of capillaries within the lobule.

PHYSIOLOGICAL FACTORS

The physiology of the gland has been intensely studied but is not well understood. The secretion enters the blood stream either through the lymphatic or blood capillaries, both of which form a complicated network through the glandular tissue. According to some authors this internal secretion has a bactericidal property. Watkins (45) believes that the renewed hormone content of the blood after it reaches the thyroid determines the failure of extraneous material carried to the gland to be readily deposited therein or to undergo the characteristic evolution there.

The physiological increase in the size of the gland together with the accompanying anatomical changes that occur at puberty, during pregnancy, during menstruation, and during severe fevers makes the gland more susceptible to infection. In fact, many of the cases of acute thyroiditis not due to direct trauma appear after a period of physiological stress. In 67 cases, 13 followed delivery, 9 followed pneumonia, 5 followed typhoid fever, and 3 occurred in young girls at puberty following acute upper respiratory infections. Females are attacked with acute thyroiditis more often than males and the highest percentage of occurrence is found during the child bearing period (20 to 40 years). Robertson (33) found 52 females in 96 cases and I found 47 females in 67 cases. Jeanselme (20) remarked in 1895 that pregnancy reacts on the thyroid and transforms it into a veritable venous sponge. Following pregnancy the thyroid hypertrophy diminishes but never completely disappears. That anatomical and physiological disturbances following this evolution and resolution occur and render the gland less resistant to infection can be readily understood.

As in the uterus and breast, structures undergoing great physiological changes during puberty and pregnancy, adenomata form frequently in the thyroid. These adenomata are sites of fibrosis, abnormal cell proliferation, blood vessel distortion, and frequent hæmorrhage, all producing areas of lowered resistance. Moreover, the adenoma produces atrophy of the surrounding acini, together with a localized fibrosis, slight inflammatory infiltration, and thickening of the blood vessel walls, a chronic non-suppurative thyroiditis, which Warthin (44) believes is due to mechanical pressure. This inflammation produces an area of lowered resistance to any extraneous material that may reach the gland. In 24 of my 67 cases adenomatous goiter was present before the acute thyroiditis developed; in 31 of Robertson's (33) 96 cases goiter was present first and in most cases was adenomatous.

To summarize, one may say that the rich blood supply and the production of the thyroid hormone tend to prevent infection of the thyroid, while the physiological changes occurring during puberty, menstruation, pregnancy, and acute infections, and the development of adenomata in the gland tend to lower the resistance of the thyroid.

PATHOLOGICAL ASPECTS

Thyroiditis may be acute or chronic, suppurative or non-suppurative and acute reactions can be ascertained clinically in the suppurative lesions. In my own case considerable necrotic tissue was removed at the operation. There were areas showing dilatation of the capillaries, polymorphonuclear infiltration of the interstitial tissue and the acini, hæmorrhage into the interstitial tissues and the acini, coagulation of the colloid, and all types of cell pathology ranging from cloudy swelling to complete necrosis. Clute and Smith (9) likewise found dilatation of the capillaries with diapedesis or frank hæmorrhage, leucocytic infiltration of the alveolar epithelium and even the lumen of the acini. They also found diminution in the amount of colloid with replacement by a granular precipitate.

The acute inflammation may resolve or go on to suppuration and gangrene. Resolution occurs by absorption of the lymph and new cells and by the changing of the angioblastic and fibroblastic tissues into vascularized fibrotic tissues. Watkins (45) found evidence of acute reaction in some of the interstitial types of thyroid removed at operation where active fibroblastic proliferation was occurring. Acute non-suppurative lesions are transitory in character, resolution occurring within a week or 10 days. Of 96 cases reported by Robertson (33), 56 were of the non-suppurative type; of my 67 cases, 4 resolved without suppuration. One of these followed delivery, one followed the grippe (and had occurred for 3 successive winters), one followed trauma to the neck and exposure to the cold, and one was primary.

Acute suppurative lesions may consist of multiple miliary abscesses or may be large pus pockets involving one or both lobes of the thyroid. Most frequently the right lobe is involved, next in frequency the left lobe, and Stein (37) reports a case in which the pyramidal lobe alone was abscessed.

Chronic non-suppurative thyroiditis of the non-specific variety is seen in the neighborhood of adenomata and is associated with pressure atrophy of the acini. There is a localized fibrosis of the interstitial tissue, slight round cell infiltration and thickening of the blood vessel walls. Of the specific non-suppurative variety tuberculosis and syphilis occur. Tuberculosis of the thyroid is characterized by the development of a hard, nodular tumor of rather rapid growth. Pathologically the picture is characterized by tuberculous granulations, fibrosis, caseation, and calcification. Microscopically the picture is typical of tuberculosis, an avascular concentrically arranged mass of cells consisting of a central area of caseation with multiple foreign body giant cells, surrounded by a ring of epithelioid cells about which is a mononuclear round cell infiltration of the lymphoid type. Secondary infection does occur and an acute thyroiditis with abscess formation may result. Vianny (42) operated on such a case. The abscess occurred in the inferior region of the neck and after incision healed in 3 months. Seven years later another abscess pointed at the inferior end of the old incision. The surgeon probed the sinus and thought the condition was Pott's disease, as there was a sensation of roughness and grating as imparted by diseased bone. He also found a sinus leading posterior to the sternum, probing at the bottom of which imparted a similar sensation and led him to believe that there was an osteomyelitis of the posterior surface of the manubrium. Only at operation did he find that he was faced with an acute thyroiditis with abscess formation superimposed on a calcified thyroid.

Syphilis occurs in two forms: the diffuse thyroiditis syphilitica and gummata of the thyroid. Davis (10) reports 17 cases of syphilis. The pathological picture is characteristic of syphilis as it appears in other tissues. In diffuse thyroiditis syphilitica, there is perivascular round cell infiltration with fibroblastic and angioblastic proliferation and a progressive endarteritis of the regional blood vessels. In the gumma there is a central, hard, firm area of coagulation necrosis, surrounded by dense tissue rich in epithelioid cells and closely infiltrated with mononuclear wandering cells. Giant cells may be present and there is usually an associated obliterative endarteritis of the smaller vessels. No acute superimposed thyroiditis with or without abscess formation has been recorded in the literature.

Riedel's (32) ligneous thyroiditis deserves consideration at this point. The etiology of this process is unknown and there is doubt as to its true inflammatory nature. It is characterized by a marked fibrosis of the thyroid with adhesions to the adjacent structures that are so firm that the condition is usually diagnosed as malignant. No report has been made of an acute inflammation superimposed on a ligneous thyroiditis.

Many pathologists on finding localized collections of lymphocytes with or without germ centers in glands examined for exophthalmic goiter, toxic adenoma, and toxic hyperplasia have called the picture "thyroiditis" and assigned this as an explanation for the toxicity. Watkins (45) however, believes that these lymphocytic cell collections are not inflammatory but are evidence of a thymico-lymphatic constitution; in other words, are evidence only of a lymphatism. Clute and Smith (9), on the other hand, believe that these cell collections are evidence of a mild inflammatory process. In considering the relationship of these cell collections and Graves' disease, they observed no evidence of these cell nests in so many toxic goiters that they feel that there is no relationship between this cellular inflammatory reaction and the glandular hypertrophy and associated increased metabolism.

The etiology and clinical significance of these cell nests is a problem; one authority maintains that they are part of a general lymphatism, while another maintains that they are due to a chronic inflammation. A third consideration might be that these are undifferentiated cells such as occur in the breast and which on proper physiological stimulation spring into activity and form acini.

CLINICAL OCCURRENCE

Acute thyroiditis occurs most commonly in the female sex. Robertson (33) reported 52 females and 32 males in 96 cases. I found

in 67 cases 47 females and 20 males. The age occurrence varies from 18 months to 77 years, the oldest being my own patient. Table I shows the age occurrence in 65 cases.

TABLE I.—AGE OF PATIENTS AT TIME OF OCCURRENCE

Age in years	No. of patients	Age in years	No. of patients
1–10	2	50–60	11
10–20	7	60–70	4
20–30	14	70–80	2
30–40	14		—
40–50	11	Total	65

Robertson (33) found in his 96 cases that the age of greatest frequency was the same as that shown in Table I (between 20 and 40 years).

The relationship between goiter and acute thyroiditis is interesting. Some authors believe that acute thyroiditis occurs only in previously diseased glands. Hagenbuch (16) reported 43 cases, of which only 5 had goiter, 32 of Robertson's (33) 96 cases had goiter, and 32 of my 67 cases suffered from goiter previous to the acute infection; 24 of these 32 were adenomatous in type, 3 showed general hyperplasia, and 5 were unclassified. Seven of the cases I studied showed toxic goiter symptoms during the acute infection; one of these, reported by Rogers (34), suffered a postinfection thyrotoxicosis; one, reported by Greenberg (14), who had suffered a severe thyrotoxicosis previous to the infection, recovered from the toxic state after the infection, although part of the gland was resected at the operation performed and this might account for the recovery; one individual, studied by Weeks (46), developed severe myxœdema after a drainage operation, from which she recovered only after the wound sinus closed; of the remaining 63 cases, 10 showed no postoperative thyroid disturbances and 53 were unclassified.

The etiological factors in acute thyroiditis are numerous. Trauma to the gland produced a severe attack of thyroiditis in a case reported by Link (26). The patient had a toxic goiter which was treated by "a rubber." An acute thyroiditis developed and at operation the gland was found to be a veritable carbuncle. Drainage was instituted but the patient succumbed. Puncture wounds with infection of the thyroid were observed during the World War. Aside from the direct trauma, infection may occur in four ways:

1. By extension through a persistent thyroglossal duct.

2. By direct invasion from contiguous structures. Cleland (8) performed an autopsy on a patient who had purulent perichondritis of the tracheal cartilages with extension of the suppuration to the thyroid.

3. By lymphatic metastases. That infection reaches the thyroid through the lymphatics is a debatable point. So many infections occur after pharyngitis, tonsillitis, and other upper respiratory infections with the associated lymphadenitis that it seems probable that organisms do reach the thyroid in this manner. The natural lymphatic current flows from the thyroid gland to the deep cervical lymph glands but with the clogging of these natural channels following severe infection in their regions of drainage, the natural drift may be stopped or even reversed and organisms be carried to the gland. In my series of cases 13 followed upper respiratory infections such as pharyngitis or tonsillitis, 1 followed multiple ulceration of the tongue, 1 followed quinsy, and 1 followed mastoiditis. Robertson had 3 cases following tonsillitis and 4 cases following diphtheria. Hagenbuch had 6 cases complicating Vincent's angina, 1 complicating tooth extraction and meningitis, and 3 cases following acute upper respiratory infections.

4. By blood stream metastases. This is the most common mode of infection. Acute thyroiditis in my series complicated typhoid fever 5 times, pneumonia 9 times, empyema once, influenza 8 times, erysipelas 3 times, puerperal septicæmia 13 times, and multiple suppurative arthritis once. Robertson had 7 cases following acute rheumatic fever, 6 cases following pneumonia, 6 following acute enteric fever, 4 following erysipelas, 4 following influenza, 4 following puerperal sepsis, and 4 following malaria. Hagenbuch reported 8 cases following influenza and 9 following pneumonia. Metastases by the blood stream is the most logical and only adequate explanation for the development of acute thyroiditis as a complication of these maladies.

The bacteria involved in infection of the thyroid are numerous. In 63 cases in which suppuration occurred the organisms isolated were: typhoid in 2 cases, paratyphoid A in 1 case, paratyphoid B in 1 case, pneumococcus in 3 cases, streptococcus in 10 cases, staphylococcus in 7 cases, streptococcus and staphylococcus in 2 cases, and staphylococcus and saprophytes in 1 case.

Robertson obtained cultures from 7 of the 41 suppurating cases and found pneumococcus in 4 cases, typhoid in 2 cases, and streptococcus in 1 case.

Briggs and Scribner (5) found 17 cases of typhoid thyroiditis besides their own case which was due to the typhoid bacillus, the organism being isolated in pure culture from the abscess cavity.

In addition, Osler and McCrae (30) state that acute thyroiditis may occur in the course of smallpox, measles, scarlet fever, and mumps. Epidemics among children and among soldiers have been reported.

CLINICAL SYMPTOMATOLOGY

The onset of acute thyroiditis is usually sudden. The first symptom in 27 of the cases studied was pain in the neck over the thyroid gland. It is lancinating in type and may radiate to the mastoid region or the ear. The pain is aggravated by extension of the head because the muscles and heavy fascia compress the swollen tender gland when the chin is elevated and as a result the patient holds the head in a bowed position.

Swelling or tumor formation over the thyroid was the first symptom observed in 25 of the 67 cases. This swelling may involve one lobe or both lobes or the whole thyroid gland may stand out in relief. The swelling may extend from the chin to the manubrium and the chin may be drawn to the diseased side by the inflammatory distention of the cervical tissues. In cases of adenomata these tumors swell rapidly while the remaining portion of the gland may show no increase whatsoever in size.

Tenderness over the thyroid gland was present in 63 of the 67 cases and in 4 cases this was the first complaint. The tenderness was exquisite in 10 of the cases.

Chills and fever initiated the disease in 20 of the cases. Fifty-seven of the patients had fever which ranged from 99 to 104 degrees. The temperature tends toward the "saw tooth" type, especially when an abscess forms in the gland.

Coughing occurred in 10 of the cases. It is spasmodic in type and is usually a harsh, dry, non-productive hacking. Occasionally mucus and blood-stained sputum is raised. Brenzier (4) reports the case of a man who had an abscess which evacuated into the larynx so that a great quantity of pus and sloughing tissue was expectorated. Gemenez and Zapiola (13) had a similar patient whose abscess ruptured spontaneously into the trachea and who coughed up a great quantity of pus. Rabattu and Gillard (31) and Theisen (38) reported cases with spontaneous evacuation into the larynx accompanied by a cough and expectoration of purulent fluid.

Hoarseness was mentioned in 12 of the cases. This is due to œdema, swelling, and venous congestion of the laryngeal mucous membrane. Complete aphonia developed in 4 cases. According to Theisen (38) this is not due to a cord paralysis from pressure on the recurrent nerve but to venous congestion and œdema, the latter occurring in the supraglottic or infraglottic region and not in the cords themselves.

Dyspnœa developed in 32 of the cases sometime in the course of the disease and in one case was the first symptom. It is due to swelling and œdema of the tracheal epithelium and to compression and displacement of the air passage by the abscess. Choking occurred in 7 of the cases, 2 were relieved by tracheotomy, incision, and drainage of the abscess; 3 were treated by the latter procedure while 2 ruptured spontaneously before surgical intervention was practiced.

Dysphagia was reported in 19 cases in 2 of which it was the first symptom. It is due to pressure on the œsophagus by the swollen gland and to œdema and inflammation of the œsophagus mucous membrane.

Partial ptosis with corneal anæsthesia due to sympathetic nerve pressure and vomiting with a slow pulse from vagus nerve pressure are mentioned as symptoms by Stein (37). I

found neither of these recorded in the case reports that I studied.

Fluctuation in event of abscess formation may or may not be present. In 26 of the cases fluctuation was obtained. The deep seated position of the gland and the heavy planes of fascia which surround and protect it make palpation for the presence of abscess formation difficult. The tumor often imparts a characteristic tense, hard sensation to the examining finger, yet there is a sensation of fluid under pressure and anterior bowing of the head to relax the overlying muscles and fascia will allow the examiner to obtain fluctuation. In 34 of the 67 cases the surgeon discovered no fluctuation although free pus was found at operation. In these cases there was a brawny, indurated consistency due to œdema and congestion of the overlying and contiguous structures.

Redness of the overlying skin occurred in 30 of the 67 cases. The redness was most marked in the fluctuating adenomata, 3 of which ruptured spontaneously either before the patient entered the hospital or before surgical intervention could be instituted. The first 4 constitute a diagnostic quadrad. Abscess formation may be determined by the pressure of fluctuation in the swollen tissue, and by the temperature and leucocytosis and the general picture of toxœmia which occurs when pus is present under tension in the body tissue.

Toxic goiter symptoms, evidenced by tachycardia, nervousness, tremor of hands, sweating, and exophthalmos developed in 7 of the cases. In 3 of these a toxic goiter was present before the onset of the acute thyroiditis.

The following symptoms and signs are therefore characteristic of acute thyroiditis:

1. Pain over the thyroid gland.
2. Swelling of the thyroid gland or of an adenoma of the thyroid.
3. Tenderness over the thyroid.
4. Chills and fever.
5. Coughing.
6. Hoarseness and aphonia.
7. Dyspnœa.
8. Dysphagia.
9. Thyrotoxicosis.

In case abscess formation occurs two other signs develop:

10. Fluctuation in the tumor mass.
11. Redness of the overlying skin.

DIFFERENTIAL DIAGNOSIS

Physiological hypertrophy of the thyroid at adolescence, during pregnancy, or during menstruation is differentiated from acute thyroiditis by the absence of pain, absence of fever, and the absence of marked tenderness.

Hæmorrhage into the thyroid gland or into an adenoma is characterized by a sudden, rapid swelling and by sharp pain at the onset, followed by a gradual subsidence of the pain. In thyroiditis, however, the swelling develops less rapidly and the pain, which is mild at first, increases in severity.

Malignancy of the thyroid has a characteristic nodular hardness and the regional lymph nodes are involved early. The sudden onset, the rapid growth, the temperature, and leucocytosis, which are characteristic of acute thyroiditis are not found in malignant cases. Tenderness may be ascertained by palpation over a malignant gland late in the disease after the regional lymph glands have been involved and the capsule of the thyroid has been broken through by the malignant growth.

Glossitis and abscess formation at the base of the tongue with the associated cervical œdema and swelling may resemble acute thyroiditis. The latter disease is unaccompanied by any pathological changes in the floor of the mouth, so that it can be ruled out by an oral examination.

Bronchial and thyroglossal cysts develop suddenly when hæmorrhage or infection of their contents occur. They are situated cephalad to the thyroid gland and are often present and recognized before the acute attack develops. No toxic goiter symptoms result from an infection in a bronchial or thyroglossal cyst. If the pyramidal lobe of the thyroid is involved alone, as already mentioned, differentiation from an infection in a thyroglossal sac may be possible only at operation.

Perichondritis of the laryngeal cartilages will produce pain, tenderness, hoarseness,

coughing, and dyspnœa. The laryngeal symptoms are more marked than in acute thyroiditis; there is an absence of any tumor formation, and the laryngoscopic examination may lead to the demonstration of the true pathology of the condition.

Cellulitis and phlegmon of the neck may be difficult to differentiate from the acute thyroiditis in which the cervical structures from the mandible to the sternum are involved. In cellulitis the swelling usually commences in the region of the mouth and spreads downward while thyroiditis begins in the gland. The swelling in cellulitis is more diffuse and follows the fascial planes. The pain is usually not marked in cellulitis at the onset and starts at the site of the original infection, while the pain of acute thyroiditis is lancinating at the onset and begins in the gland. Thyrotoxic symptoms are absent in a cervical cellulitis unless there is an associated toxic goiter, in which event the toxicity will certainly be aggravated. A diagnosis may be impossible without operation.

PROGNOSIS

The prognosis in acute thyroiditis is excellent if the disease is recognized and treated properly. Resolution occurs in 10 to 14 days in the non-suppurative type. In the suppurative type the prognosis for recovery is good but the convalescence may be long and stormy. Complications, such as perforation into the larynx or trachea, mediastinitis, pyæmia with secondary infection of the bursa, joints, and bones, as occurred in my case, postoperative myxœdema, and thyrotoxicosis may well nigh exhaust the patient. Recurrences have been reported. Vianny (42) treated a suppurative case by drainage but the infection recurred 7 years later and incision and drainage were again necessary before complete recovery was obtained. Sherris (36) treated a man with acute thyroiditis of the non-suppurative type, who had had similar attacks for 4 successive winters. Death occurred in 2 of Hagenbuch's (16) 47 cases. In the non-suppurating cases 2 of 55 patients died, and in the suppurating type 9 of the 41 died, making a total of 11 deaths in the 96 cases reported by Robertson (33). In my series of 67 cases, 11 patients died and 56 recovered, making a death total of 24 in 210 or a mortality rate of 11.4 per cent.

TREATMENT

The general treatment in acute thyroiditis is directed toward relief of the general malaise, chills and fever, headache, sleeplessness, and pain. Ice caps to the head, coat tar antipyretics, codeine or morphine if the pain is very severe, saline cathartics in doses sufficient to produce a good daily bowel movement, and tepid sponges in event that the temperature rises over 102 degrees are helpful. A liquid diet is necessary in some cases because of the dysphagia and in such an event nourishment should be given every 2 hours during the day. Nutritious drinks such as cocoa, egg-nogs, well sweetened orange juice, and milk are preferable. If the patient does not suffer from dysphagia a regular house diet supplemented with mid morning and afternoon feedings is best. In specific inflammations specific curative measures are indicated. Typhoid vaccine, pneumococcus serum, and meningococcus serum have been used in thyroiditis complicating typhoid, pneumonia, and meningitis.

The local treatment in acute non-suppurative thyroiditis consists in the application of cold or heat. Ice packs during the stage of enlargement and œdema, that is during the first 24 to 48 hours, are used in an effort to limit congestion. Dry heat is then applied to hasten resolution. If ice packing allays the pain better than heat, it should be used as long as it is efficacious.

If suppuration ensues in spite of treatment as it did in 30 of Hagenbuch's 43 cases, in 40 of Robertson's 96 cases, in 63 of my 67 cases, prompt incision and drainage is the best treatment. Delayed resolution with persistence of the symptoms of toxæmia beyond the 10 to 14 day period, an irregular fever, increase in the pain, steady increase in the size of the tumor with the associated pressure symptoms, indicate abscess formation. Fluctuation may be ascertained but this is not essential for a diagnosis because the heavy fasciæ, swelling, and œdema of the contiguous parts can mask suppuration in the thyroid gland very easily. Large monolocular or multilocular abscesses require incision and

drainage. Various incisions have been made, such as vertical incisions in the midline, incisions along the anterior border of the sternocleidomastoid muscle in the presence of unilateral swellings, and incisions made transversely over the most dependent area of the swelling, but the best approach is secured by a collar incision through the skin and platysma muscle. The intermuscular fascia is then split longitudinally and the sternohyoid and sternothyroid muscles are retracted laterally on either side until exposure of the inflamed gland is obtained. Lahey (24) believes that the ribbon muscles should be severed on either side through part of their width at least so that the longitudinal incision in the intermuscular fascia will gape and promote free drainage. After the abscess has been exposed it is opened widely if rupture has not already occurred during the operation. The cavity is then sponged out gently. Although many surgeons favor curetting the walls, this method is contra-indicated because blood vessels may be opened and dangerous hæmorrhage result. Mosetig (29) reports such a case of fatal postoperative hæmorrhage. Drainage is best insured by a good sized, hard rubber tube. The tube may have multiple perforations cut along its sides and may be split part of its length, the two split pieces being separated when the tube is placed, one piece going to each pole of the infected lobe so that free drainage is insured from the most remote areas after collapse of the abscess wall occurs. In case both lobes of the thyroid have suppurated, two such tubes should be used.

In the cases of multiple miliary abscess formation in the gland, subtotal thyroidectomy has been practiced. This is a dangerous type of infection. Schiver (35) reports two fatal cases. Link's (26) patient died, but Greenberg's (14) recovered, giving a mortality of 75 per cent in the cases that I studied.

In the presence of suppuration in a single adenoma, Vianny (42) practiced strumectomy of the abscessed adenoma in 4 cases, drained and performed a secondary strumectomy in 2 cases, and executed a simple incision in one case. Clute and Smith (9) believe that the abscessed adenoma should be removed if the local and general condition of the patient will permit. The more conservative procedure of incision and drainage with secondary strumectomy after the acute attack subsides appeals to me as based on sound surgical principles.

SUMMARY

1. Acute thyroiditis occurs often enough so that the members of the medical profession should be cognizant of its existence as a clinical entity.

2. Acute thyroiditis is characterized by a quadrad of symptoms: (1) pain over the thyroid, (2) swelling or tumor formation over the thyroid, (3) tenderness over the gland, and (4) fever.

3. Conservative measures are indicated in the non-suppurative variety. Surgery is always indicated in event of suppuration.

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THE BACTERICIDAL ACTIVITY OF HEXYLRESORCINOL (SOLUTION S. T. 37) ON WOUND SURFACES

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THE bactericidal activity of hexylresorcinol in glycerine has been previously described (2). Certain experiments by the writers which have led to the selection of hexylresorcinol in 30 per cent aqueous glycerine (solution S. T. 37) as the solution best suited for the purposes of general antisepsis have been reported in a previous communication (3).

The purpose of the present article is to describe a simple technique by which the suitability of any given germicide for use as a prophylactic against infection in accidental or operative wounds may be readily determined and to describe the results obtained in the rapid disinfection of experimentally infected wounds with solution S. T. 37.

In the first place, most germicides suffer a marked loss in bactericidal activity in the presence of organic matter which is, of course, present in every wound and on all mucous surfaces. In the case of certain types of germicides, this loss of bactericidal power may be practically complete in the presence of 3 per cent of organic matter (2 per cent of peptone and 1 per cent of gelatin) which is the standard adopted by the U. S. Hygienic Laboratory (1). Such germicides are obviously unsuitable as prophylactic agents. It would appear to be logical, therefore, to test a given germicide in the presence of the standard concentration of organic matter before proceeding to any actual experiments on wounds and to determine this activity not only in the standard peptone-gelatin mixture but also in the same concentration of normal serum and of whole blood as well, for the reason that this is the particular type of organic matter met with under practical conditions in wound disinfection.

The bactericidal activity of solution S. T. 37 in the presence of 3 per cent peptone-gelatin, blood serum and whole blood is shown in Table 1. These experiments were conducted at 37 degrees C., 5 cubic centimeter amounts of solution S. T. 37 containing the requisite quantity of organic matter being inoculated with one standard 3 millimeter loopful of a 24 hour filtered broth culture of the test organism, the same inoculum being transferred to 10 cubic centimeters of fresh beef infusion broth at each of the time intervals indicated, and the tubes then incubated for 48 hours.

The test organisms and the time intervals chosen for these experiments are the same as those employed in the tests on wound disinfection described below. As shown in the table, solution S. T. 37 was found to be completely effective in 1 minute against each of the four test organisms, in the presence of the standard concentration of peptone-gelatin solution, normal horse serum and citrated rabbit's blood.

RAPID DISINFECTION OF EXPERIMENTALLY INFECTED WOUNDS WITH HEXYLRESORCINOL (SOLUTION S. T. 37)

In the technique to be described, an attempt has been made to standardize controllable

TABLE I. — THE BACTERICIDAL ACTIVITY OF SOLUTION S.T. 37 IN THE PRESENCE OF THREE PER CENT ORGANIC MATTER (U. S. HYGIENIC LABORATORY STANDARD)

Organic matter	Test organisms	Time of exposure to germicide			Controls*
		1 min.	2 min.	5 min.	
Peptone-gelatin	Staphylococcus aureus	O	O	O	+
	Streptococcus viridans	O	O	O	+
	Streptococcus hæmolyticus	O	O	O	+
	Bacillus coli	O	O	O	+
Normal horse serum	Staphylococcus aureus	O	O	O	+
	Streptococcus viridans	O	O	O	+
	Streptococcus hæmolyticus	O	O	O	+
	Bacillus coli	O	O	O	+
Citrated rabbit blood	Staphylococcus aureus	O	O	O	+
	Streptococcus viridans	O	O	O	+
	Streptococcus hæmolyticus	O	O	O	+
	Bacillus coli	O	O	O	+

+: Growth. O: Sterile.
*Organic matter, 3 per cent in physiological saline solution.

conditions with a view to developing a simple but dependable method by which the suitability of a given germicide for use as a prophylactic agent in fresh wounds might be readily determined in any laboratory. Such considerations as trauma, as by crushing, and the presence of foreign material in the wound are not considered in this technique, for the reason that they cannot be readily standardized. The method merely represents a test, under standard conditions, by which the efficiency of a given germicide to disinfect a wound surface within a given time may be determined.

Selection of test organisms. Staphylococcus aureus was selected as a test organism, not only because it is commonly responsible for wound infection, but also because it is generally considered to be the most resistant of the pyogenic cocci to disinfection by chemical means. Streptococcus viridans and streptococcus hæmolyticus were included because of the frequency and the seriousness of wound infection by these organisms. Bacillus coli was chosen to represent the Gram-negative organisms because of its resistance to chemical disinfection and because it is not infrequently responsible for wound infection.

Media and preparation of cultures. Staphylococcus aureus and bacillus coli were transferred daily in standard peptone (Armour's) broth of pH 6.6–6.8, while the two streptococcus cultures were transferred daily in fresh beef infusion broth (pH 6.6–6.8) until luxuriant growth appeared on 24 hours incubation. Thereafter all cultures were transferred daily in the respective media and fresh 24 hour cultures invariably used in the tests.

Preparation of bacterial suspensions for wound inoculation. The day before the wound experiments were to be made, the number of organisms in the 24 hour broth culture to be used was determined by plating out in fresh beef infusion agar, 1 cubic centimeter of each of a series of dilutions in physiological saline solution. After 24 hours' incubation of the plates at 37 degrees C. the colonies were counted and the broth culture, which had meantime been stored in the ice box at 3 degrees C., was then diluted with the calculated quantity of physiological saline solution to give a suspension containing 200,000 organisms per cubic centimeter. The counts were checked once or twice for each culture after 24 hours' storage in the ice box and were never found to vary to any considerable degree. A suspension containing 200,000 organisms per cubic centimeter was chosen for the reason that 0.5 cubic centimeter of fluid was found to cover completely the entire wound surface employed. This inoculum contained, therefore, 100,000 organisms, evenly distributed over the wound surface—a figure which was selected arbitrarily but which, it was felt, represented an inoculum well above the average accidental infection.

Preparation of the animal. Guinea pigs were used exclusively in these experiments. The pig being held by an assistant, the hair was first removed from the abdomen with ordinary clippers and the entire abdomen

Fig. 1. Showing the wound, the application of the germicide by means of a gauze sponge and the method of taking wound cultures at definite time intervals.

shaved. Ether was then administered and the pig securely tied down on an ordinary wire test tube rack as for a laparotomy. The skin of the abdomen was thoroughly wiped off with a sterile gauze or cotton sponge saturated with solution S. T. 37 and a fresh sterile gauze sponge saturated with the solution placed over the operative field, where it was allowed to remain about a minute.

A triangular skin flap, with the upper angle in the mid line about 2 to 3 centimeters below the xiphoid process, was next laid back, to expose a triangular area of the anterior abdominal fascia measuring about one inch along each side.

Wound inoculation. One-half cubic centimeter of the suspension of the test organism, containing about 100,000 viable organisms, was allowed to flow into the wound from a sterile graduated pipette, even distribution of the material over the wound surface being facilitated with the point of the pipette, when necessary.

First control. A sterile swab consisting of the ordinary wooden applicator stick with an absorbent cotton end and sterilized in an individual test tube was then stroked over the wound surface and the material transferred to the surface of a plain agar or blood agar plate, depending on the organism used. This constituted the first control, to prove the viability of the organism on the media used and also that the inoculation had, in fact, been made as intended.

Second control. A gauze sponge saturated with solution S. T. 37 was then placed over the wound, covering the entire wound surface. Thirty seconds later the sponge was lifted and the wound surface stroked with a sterile cotton swab *which was then dipped in the saline suspension of the organism* and the material transferred to the surface of an agar plate. This constituted the second control and covers a point seldom controlled in experiments of this kind—namely, the possibility of transferring sufficient germicide on the culture swab to prevent the growth of any viable organisms which may have been transferred with it. The appearance of growth in the second control plate rules out the possibility of such an occurrence in the wound cultures taken subsequently.

Wound cultures. At the expiration of exactly one, two, and five minutes after application of the germicide, the gauze sponge was lifted, a sterile swab stroked over the wound surface and then transferred to the surface of an agar plate. This is illustrated in Figure 1.

In the transference of the material removed by the swab to the surface of the agar plate, the same procedure is invariably followed: the swab is stroked rapidly back and forth along one diameter, the swab meantime being rotated in the fingers of the right hand, with a twisting motion, and the plate gradually being rotated with the left hand until one complete revolution had been made. This brings every portion of the surface of the swab into direct contact with the agar and distributes the material evenly over the surface of the plate.

All plates were incubated for 48 hours at 37 degrees C. before the results were recorded.

This experiment was repeated three times with each of the four test organisms. As shown in Table II, the first and second controls showed satisfactory growth in every case, while in no case did solution S. T. 37 fail to effect complete disinfection of the wound surface within 1 minute. The appearance of

TABLE II.— DISINFECTION OF FRESHLY INOCULATED WOUND SURFACES WITH HEXYLRESORCINOL (SOLUTION S. T. 37)

Guinea Pig No.	Test organism	Control before germicide	Control after germicide	Wound cultures		
				1 min.	2 min.	5 min.
1	Staphylococcus aureus	+	+	O	O	O
2	Staphylococcus aureus	+	+	O	O	O
3	Staphylococcus aureus	+	+	O	O	O
4	Streptococcus viridans	+	+	O	O	O
5	Streptococcus viridans	+	+	O	O	O
6	Streptococcus viridans	+	+	O	O	O
7	Streptococcus hæmolyticus	+	+	O	O	O
8	Streptococcus hæmolyticus	+	+	O	O	O
9	Streptococcus hæmolyticus	+	+	O	O	O
10	Bacillus coli	+	+	O	O	O
11	Bacillus coli	+	+	O	O	O
12	Bacillus coli	+	+	O	O	O

The time intervals, 1, 2, and 5 minutes refer to the time elapsed between applying the germicide and taking the wound culture.
+: Growth. O: Sterile.

the control plates and one minute plates is shown in Figure 2.

The standardized technique described takes no account of wound infection by spores. The actual destruction of ordinarily resistant spores on tissue surfaces, without tissue destruction is almost inconceivable to one familiar with the extraordinary resistance shown by these bodies to disinfection by chemical means in spite of reports to the contrary occasionally appearing in clinical literature. In the experiments upon which these reports are based the fact is almost invariably overlooked that the presence of extremely minute quantities of almost any germicide or antiseptic transferred to the culture medium with viable spores will completely prevent their germination.

Spores, in themselves, can do no harm, since germination of the spore is an essential

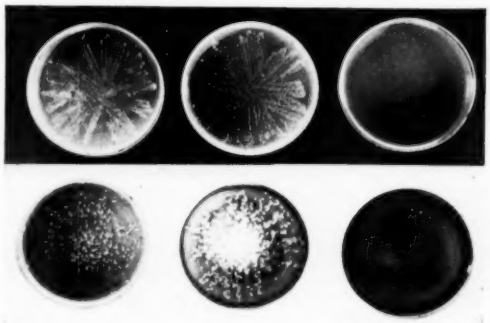

Fig. 2. Appearance of control plates and wound culture plates. Top row, staphylococcus aureus; bottom row, streptococcus hæmolyticus.

In each row the plate at the left (first control) shows the result of the wound culture taken before application of the germicide. The growth shown on the middle plates (second control) proves that insufficient germicide was transferred on the culture swab to prevent growth of the organisms. The sterile plates at the right in each row show the result of the wound cultures taken 1 minute after application of the germicide.

preliminary to bacterial activity. Fortunately, then, the problem of prophylaxis in accidental wounds which may contain spores in the infectious material present resolves itself, as far as the spores are concerned, into that of preventing their germination. The complete prevention of germination (sporostasis) by minute quantities of antiseptics or germicides bears no relation whatever to the resistance of the spore to disinfection. For example, the stock strain of bacillus subtilis carried in this laboratory produces spores which survive boiling for 30 minutes and exposure to a saturated aqueous solution of phenol for 30 minutes, yet the presence of hexylresorcinol in so minute a concentration as 1:60,000 completely prevents the germination of these spores under conditions which otherwise result in prompt and luxuriant growth.

In general it may be considered that the problem of efficient wound prophylaxis is that of promptly killing off vegetative contaminants and of leaving enough of the prophylactic agent in the wound to prevent the germination of spores. A point which one finds but seldom discussed in the large literature on this subject is the fact that moisture, may be, under ordinary circumstances, absolutely essential to disinfection by chemical

means. To be really effective, the germicide should be present *in solution*. Germicides which evaporate rapidly, such as tincture of iodine, may be very logically suspected of exerting only a very transient bactericidal action on tissue surfaces. Whether or not bactericidal activity continues after evaporation, through the deposit of the solid constituents of the solution in the tissue moisture and in stained tissue, is a highly controversial point, and little evidence of experimental nature can be offered for one or the other view. Consideration of this point, however, leads one inevitably to the conclusion that, in the absence of satisfactory proof, the safest method of applying a prophylactic agent would appear to be by means of wet dressings or at least by means of a solution which evaporates slowly.

The simple method described in detail above is presented as one which may be employed in any bacteriological laboratory to determine, under standard conditions, the suitability of any preparation as a prophylactic agent for wounds.

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THE SURGICAL TREATMENT OF GASTRIC AND DUODENAL ULCER

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NO problem in the borderline between medicine and surgery has caused more discussion and divergent opinion than has the subject of gastric and duodenal ulcer. In spite of extensive pathological studies of both clinical and experimental material, the pathogenesis of gastroduodenal ulceration remains a matter of conjecture and debate. The indications for, and the results of, medical and surgical therapy are similarly topics extensively discussed. Furthermore, the surgical profession is by no means united in its opinions with regard to the operative methods to be employed. In the absence of concrete proof of the etiology of ulcer, it is apparent that the value of surgical procedures, in their ultimate analysis, must rest upon the permanent results achieved and not upon a theoretical consideration of possible causative factors.

Notwithstanding the deficiencies in our knowledge of gastroduodenal ulcer, it must be granted that much progress has been made in the past 20 years. One of the most important contributions to these advances has been the roentgenographic study of the stomach and duodenum, which has not only been of the greatest assistance in the precise diagnosis of gastroduodenal ulcer but it has added immeasurably to our concept of the physiology of the stomach and the effect of surgical procedures. Operative methods of all types have been employed in great number and their failure as well as their success has been enlightening. In recent years the introduction of subtotal gastric resection has afforded an unusual opportunity for studying fresh pathological specimens. One cannot but feel that the problem of ulcer is a many facetted one, and should call for concerted study by the pathologist, roentgenologist, internist, and surgeon. It is obvious that only through such co-operation can progress be made.

During the past year the writer has had the privilege of serving as a voluntary assistant to Professor von Haberer at the University Clinic at Graz. The primary purpose of this article is to report on a series of ulcer cases operated upon by Haberer from January 1, 1925, to January 1, 1927. This series was selected because it represented the first group of cases operated upon by Haberer after his arrival in Graz as the successor to von Hacker. This group has the obvious disadvantage of permitting only a short follow-up period, but on the other hand it epitomizes the experiences which von Haberer has gained through having performed previously over 1500 gastric resections.

HISTORICAL

Although scattered references to gastric ulcer can be found in the medical literature as far back as the year 1600, Cruveilhier (10) in 1828 was the first to describe systematically the clinical symptoms and pathological findings. These were confirmed by Rokitansky (34) in 1839. Duodenal ulcer was described by Travers (37) in 1817, Broussais (7) in 1823, and Abercrombie (1) in 1830. The significance of duodenal ulcer was overlooked however, until the decade 1900 to 1910 when its importance and frequency were emphasized by the writings of Moynihan (24) and W. J. Mayo (22). With the advent of improved roentgenographic methods of gastro-intestinal diagnosis the differentiation of gastric and duodenal ulcers was greatly simplified.

Present day gastric surgery began with the experimental researches of Gussenbauer and von Winiwarter (13) which were undertaken in Vienna in 1875. They successfully performed gastric resections on dogs at the suggestion of Billroth, who was considering the feasibility of a similar procedure in the radical treatment of pyloric carcinoma. It is interesting to note, in passing, the seemingly prophetic words of Gussenbauer who stated in 1876 that gastric resection might be as useful in the therapy of gastric ulcer as in the treatment of gastric carcinoma.

The success of the experimental studies of Gussenbauer and von Winiwarter led Péan

(30) in 1879 to attempt the first gastric resection on a patient suffering from gastric carcinoma. The stomach and duodenum were united end to end after partial closure of the upper half of the cut end of the stomach. The patient died of peritonitis on the fifth day after operation. Rydygier (35) in 1880 made a similar attempt in a case of gastric carcinoma but was likewise unsuccessful. The first successful gastric resection on record was performed by Billroth (5) in 1881 on a woman with an extensive pyloric carcinoma. The stomach and duodenum were united end-to-end and this method of gastric resection is now generally known as the Billroth I, although in France it is often referred to as the Péan operation.

Woelfler (39) in 1881, at the suggestion of his friend Nikoloidoni, performed an anterior gastro-enterostomy on a case of inoperable gastric carcinoma with pyloric obstruction. Little did he think that this procedure was to be the foundation for the most common gastric operation. The occurrence of obstruction of the transverse colon after Woelfler's technique led Courvoisier (9) to suggest bringing the loop of jejunum through a slit in the transverse mesocolon and suturing it to the anterior wall of the stomach. In 1885 von Hacker (16) carried out the first posterior gastro-enterostomy and with minor modifications this is essentially the operation performed today.

Deaths following the Billroth I method of gastric resection led to the belief that this method entailed undue tension on the sutures establishing the end-to-end gastroduodenal anastomosis and it was, therefore, suggested that the stomach and duodenum be closed blindly and the continuity of the gastro-intestinal tract re-established by a gastrojejunostomy. This operation has been the subject of many modifications, the most important of which were suggested by Kroenlein (21), Mikulicz (23), Hofmeister (17), Pólya (31), Reichel (32), Moynihan (25), and Balfour (3). Since the underlying principle remains unchanged the operation should be termed the Billroth II.

Doyen (11) in 1893 proposed that gastro-enterostomy should not be restricted, as it had been hitherto, to cases of pyloric ulcer, but that it should be employed in all cases of duodenal ulcer associated with severe pain and hyperacidity. He argued that these symptoms were due to spasm of the pylorus and that gastro-enterostomy was, therefore, the logical procedure. The following years comprised the golden era for gastro-enterostomy. The operation grew rapidly in popularity and for some time was even employed in cases which presented only gastric symptoms but no positive operative findings. In this latter group the functional results were disastrous and necessitated secondary operation for the disengagement of the gastro-enterostomy stoma.

It was not long before surgeons began to be confronted with unfavorable results after gastro-enterostomy for ulcer. Persistence of symptoms often in exaggerated form was not uncommon, particularly in cases of gastric ulcer. Furthermore, instances were reported of hæmorrhage, perforation, and malignant degeneration of gastric ulcer and compelled surgeons to resort to other methods than simple gastro-enterostomy. Riedel (33) and Payr (29) performed sleeve resections of the stomach, leaving the pylorus intact. Eiselsberg (12) proposed occlusion of the pylorus by dividing the antrum pylori and then performing a posterior gastro-enterostomy, but this led to a relatively high percentage of jejunal ulcers. Finally, since 1915 extensive gastric resections have been employed in cases of both gastric and duodenal ulcer. Billroth I has been recommended chiefly by Haberer whereas other surgeons have favored various modifications of the Billroth II.

PATHOGENESIS

Numerous theories have been advanced to explain the development of ulcer, but all of them have as their starting point certain accepted clinical and pathological data which they seek to explain by an inductive method. Although these theories lack clinical and scientific proof, their consideration is none the less valuable in relation to the empirical facts of ulcer surgery.

Before passing on to a discussion of ulcer theories, it is desirable to review briefly a few important facts with regard to the anatomy and physiology of the stomach. The stomach

has been arbitrarily divided in many ways by different authors, but in this report the well known Holznecht classification into pars pylorica, pars media, and pars cardiaca will be employed. The pars pylorica is the motor portion of the stomach, hence the term pars egestoria. The pars media and cardiaca constitute the digestive part of the stomach, thus giving rise to the term pars digestoria. Histologically the mucous membrane of the pars pylorica is characterized by its mucous glands, whereas the acid and peptic cells are found in the pars media and cardiaca. The pyloric glands extend further upward on the lesser curvature than they do on the greater curvature. That portion of the lesser curvature which extends from the pars cardiaca to the pars pylorica constitutes the "magenstrasse" of Waldeyer. Here the mucous membrane is stretched tightly over the underlying structures in contrast to the loose folds of mucosa which are found along the greater curvature and in the pars cardiaca. The blood supply of the stomach is mainly furnished by four great arteries, although the pars cardiaca receives several branches through the vasa brevia. There is no doubt that the blood supply of the lesser curvature is less than that of the greater curvature and that the least vascular area of the lesser curvature corresponds to the pars media where the terminal branches of the pyloric artery and gastric artery anastomose. The arterioles supplying the gastric mucosa are end arteries and their occlusion therefore results in a conical infarction of the mucous membrane.

Two phases of gastric secretion are commonly recognized; the primary or psychic and the secondary or chemical. The first is dependent upon stimuli arising from the thought and the sight of food, mastication, and deglutition. The second phase is chemical and depends upon the contact of food with the pyloric mucous membrane. It is assumed that the control of acid secretion by the pyloric glands is a nervous mechanism, although this assumption lacks physiological proof. At all events resection of the lesser curvature and distal two-thirds of the stomach as performed in the radical treatment of ulcer results in either a complete absence or great dimunition of the free hydrochloric acid content of the gastric juice. This change occurs even though many acid cells remain in the proximal part of the stomach.

As Cruveilhier pointed out, the defects occurring in the normal continuity of the stomach may be divided into two forms; the erosion, which is a superficial mucosal defect, and the ulcer, which extends into the deeper layers. Aschoff has emphasized the necessity of separating these two types in considering the pathogenesis of ulcer and most writers are in accord with this view. Aschoff (2) has conveniently classified the erosions of the stomach into two groups. The first form occurs chiefly along the greater curvature in the pars media and pars cardiaca. The erosions are extremely small and numerous, they are barely visible to the naked eye, and are characterized by a tendency to heal. Gastric erosions of the second type are considerably larger and occur in smaller number along the *magenstrasse*. As contrasted with the former group, they are deeper and heal more slowly.

It is beyond the limits of this article to describe fully the many explanations which have been advanced for the pathogenesis of gastric erosions. The earliest theory was suggested by Virchow (38), who thought that they were due to organic changes in the blood vessels. Von Bergmann (4) has maintained that due to disturbances in the vegetative nervous system the blood vessels of the gastric mucosa undergo spasmodic contraction leading to areas of anæmic infarction. Other investigators have called attention to the presence of intestinal epithelium in the gastric mucosa and suggest that these islands of aberrant intestinal epithelium have a lowered resistance to the digestive action of gastric ferments. Konjetzny and Puhl (20) believe that the occurrence of gastric erosions is dependent upon inflammatory changes in the gastric mucosa and that the erosions are the product of a diffuse gastritis. Finally, there is a small group of workers who feel that the erosions are the result of pure mechanical trauma. Irrespective of how divergent these theories are, it must be stated that they have one common factor, namely, that the actual destruction of the gastric mucosa is the result of digestion by gastric ferments.

The pathogenesis of gastroduodenal ulcer is obviously of greater clinical importance than the origin of gastric erosions. As regards the relation of erosion to ulcer, it cannot be denied that the primary stage of ulcer is necessarily a superficial defect in the mucous membrane. In fact, Konjetzny and Puhl have argued that erosions are simply a stage in the development of ulcer. As pointed out by Orator and Metzler (28) this conception is refuted by the fact that in their researches only 26 per cent of the gastric ulcers and 18 per cent of the duodenal ulcers were accompanied by gastric erosions. Furthermore, they found erosions in cases of primary gastrocarcinoma as well as in cases of gastroptosis and antrum gastritis. Aschoff (2) has maintained that the frequency of ulcers in the region of the lesser curvature is due to the fact that erosions of the magenstrasse are continually exposed to both chemical and mechanical insult. This theory fails to explain the occasional occurrence of ulcers near the greater curvature. Von Bergmann is of the opinion that the same neurogenic factors which cause gastric erosions also lead to ulcer formation and calls attention to the frequency of vegetative stigmata in ulcer patients and their tendency to vasomotor instability.

The disappointing feature of studies in gastroduodenal ulcer has been the failure to produce experimentally the clinical equivalent of a chronic ulcer. Gastric erosions and catarrh have been produced by injection of the gastric vessels with lycopodium, by electrical irritation of the vagus nerves, and by administration of picrotoxin and pilocarpin. However, the lesions have always been superficial and characterized by a marked tendency toward rapid healing. These experiments are nevertheless of interest in demonstrating that pathological changes in the stomach may be induced by different methods. They coincide with the view expressed by Orator and Metzler that the various theories of ulcer are not necessarily contradictory but can be made to accord with the empirical facts of ulcer surgery.

PATHOLOGY

One of the most interesting features of the pathology of gastroduodenal ulcer is a study of site of predilection. Of the 81 cases of gastric ulcer the lesion in 77 cases was found in the pars media. In 34 of these cases the lesion was located on the lesser curvature, in 30 on the posterior wall, and in 3 on the anterior wall. There were 4 instances of ulcer of the pars pylorica.

The duodenal ulcers were distributed in circular fashion around the first portion of the duodenum, as a rule within 2 centimeters of the pylorus. In 54 per cent of the cases the ulcers were multiple. This was particularly true of the ulcers of the anterior wall, which were associated with posterior wall ulcers in 78 per cent of the cases. In many instances the ulcers which were found along the lesser curvature of the duodenum extended along the anterior and posterior walls of the duodenum in saddle fashion. The cases of pyloric stenosis were invariably due to cicatricial contraction of the duodenum, resulting from the healing of confluent duodenal ulcers. There were no ulcers in the infrapapillary portion of the duodenum.

Since, in 17 cases there were ulcers in both the stomach and duodenum, a single etiology for both gastric and duodenal ulcer was therefore suggested. The position of these ulcers differed in no wise from those previously described.

In 10 cases the jejunal ulcers were situated, as described by Chiari (8), along the mesenteric border of the jejunum at a point opposite the gastro-enterostomy stoma. In 6 cases the ulcer was in the efferent loop and in 4 cases in the afferent loop.

In addition to the findings in the stomach and duodenum the perigastric changes were also of considerable importance. Practically all cases showed an enlargement of the lymph nodes along the lesser and greater curvatures, irrespective of whether the ulcer was in the stomach or duodenum. The enlargement was usually most marked toward the pylorus and all of the cases were associated with a certain degree of perigastritis and periduodenitis. The ulcers of the posterior wall of the stomach were frequently adherent to the pancreas, in many cases there being a perforation of the base of the ulcer into the substance of the pancreas. The ulcers of the lesser curvature of the stomach were associated with inflammatory

changes in the gastrohepatic omentum. The ulcers of the lesser curvature of the duodenum were often accompanied by such extensive inflammatory changes in the hepatoduodenal ligament as to cause serious distortion of the common bile duct.

The gall bladder was routinely examined in all cases and 7 instances of cholecystitis with cholelithiasis were found. Two cases were associated with gastric ulcer and 5 with duodenal ulcer. Five of these patients were women and 2 were men. From these findings it is hardly probable that cholecystitis bears any causal relationship to the development of ulcer.

The appendix was not examined except in rare instances inasmuch as Haberer does not consider it to be of any etiological importance in the production of gastroduodenal ulcer.

No instances of epigastric hernia were noted and it is not conceivable that their presence could have been overlooked, as a median supra-umbilical incision was used in all cases.

Histological studies were made of the gastric mucous membrane in 100 cases. In every instance there was an extensive inflammatory change in the mucosa of the pars pylorica, whereas the mucosa of the partes media and cardiaca was free from histological abnormalities except when the section was taken from the immediate vicinity of an ulcer. These findings confirm the reports of Stoerk (36), Konjetzny (19), Orator (26), and others.

On account of the renewed interest which the work of Konjetzny has stimulated in the possible relationship of gastric erosions and gastroduodenal ulcer, all specimens were examined for the presence of erosions immediately after operation. As is shown in Table I, erosions occurred in a considerable percentage of cases. As these erosions were invariably on a background of a catarrhal gastritis the condition is designated here as a gastritis erosiva. In addition, there were specimens which presented acute ulcerations of recent origin and this finding has been given the name of gastritis ulcerosa.

TABLE I.

	No. of cases	Gastritis erosiva	Per cent	Gastritis ulcerosa	Per cent
Gastric ulcer	68	18	26	9	13.1
Duodenal ulcer	163	31	18	17	10.0
Jejunal ulcer	19	3	20	..	....

In analyzing the group of gastric ulcers associated with erosions, it is interesting to note that one-half of the ulcers were of the noncallous variety. It is of greater import, however, that there were no instances of noncallous ulcer unaccompanied by erosions or superficial ulcerations. It seems plausible, therefore, to assume that gastric erosions are of significance in the development of noncallous gastric ulcers and of secondary importance for the production of callous ulcers.

In the groups of gastric ulcers there were 3 cases which showed malignant degeneration along the ulcer margin. All of these cases were situated in the pars pylorica, which in the experience of the Graz clinic is the favorite site of localization for gastric carcinoma. Roentgenologically all of these cases had shown a typical niche. Histologically the specimens showed the characteristic ulcer defect in the muscularis with partial infiltration of the ulcer margin by carcinomatous cells. There were no instances of malignant degeneration of duodenal or jejunal ulcer.

INCIDENCE

The incidence according to age and sex is shown in Table II. Among the gastric ulcers there were 10 instances of hour-glass stomachs and 9 of these occurred in women. The majority of patients under 30 years of age were males with duodenal ulcer.

TABLE II.—AGE AND SEX

Age in years	10–20	20–30	30–40	40–50	50–60	60–70	70–80	Total
Gastric ulcer								
Male	..	6	14	11	11	4	1	47
Female	..	..	7	13	12	2	..	34
Total								81
Duodenal ulcer								
Male	2	46	40	31	21	7	..	147
Female	1	3	3	7	5	..	..	19
Total								166
Gastric and duodenal ulcer								
Male	..	2	2	6	3	..	..	13
Female	..	1	..	2	1	..	..	4
Total								17
Jejunal ulcer								
Male	..	7	3	5	3	..	..	18
Female	..	1	1	..	..	..	..	2
Total								20

SYMPTOMATOLOGY

There was nothing of unusual interest in the clinical symptoms. The greater number of patients were ill for a period of over 3 years prior to operation. The patients with gastric

ulcer or ulcer of the posterior wall of the duodenum showed a tendency to hæmatemesis and melæna. There were no factors in either the habits or personal history of the patients to which an etiological significance for the production could be ascribed. Many cases presented a family history of gastric disturbances suggestive of ulcer. One man who was operated upon for a duodenal ulcer related that his father and two brothers had been similarly operated upon. Another male patient was operated upon for gastric ulcer in 1926 and in the following year his two brothers underwent similar operations at Graz.

GASTRIC ACIDITY

Gastric acidity was determined by examining the stomach contents one-half hour after a meal of tea and rolls. Although there were many cases of marked hyperacidity, this finding was by no means constant. As a general rule the acid content was higher in cases of duodenal ulcer than in cases of gastric ulcer. Studies of the acid content of the stomach after gastric resection showed either a total absence of free hydrochloric acid or else greatly reduced figures.

ROENTGEN STUDIES

Except in those instances in which roentgen examination was contra-indicated because of recent hæmorrhage or the fear of impending perforation, every patient was subjected to routine fluoroscopic examination after the ingestion of a barium meal. Films were made only in rare cases and purely for purposes of record. The presence of a niche was demonstrated in 97 per cent of the cases of gastric ulcer. The diagnosis of duodenal ulcer was made on the basis of persistent duodenal deformity and the presence of a niche which was found in 98 per cent of the cases. In the group of jejunal ulcers, which have always presented a difficult problem for roentgenological diagnosis, direct evidence of the existence of an ulcer was obtained in 10 out of a total of 18 cases.

Prior to discharge, all cases were re-examined fluoroscopically so that the functioning of the anastomosis could be studied and the size of the stomach observed.

TECHNIQUE

Prior to April, 1925, ether anæsthesia was usually employed, although a small group of cases were operated upon under infiltration anæsthesia of the anterior abdominal wall. Since that time local and splanchnic anæsthesia have been used in practically every case, except in those cases in which the presence of adhesions resulting from a previous operation made its use inadvisable. The anæsthetic solution was a 0.25 per cent solution of tutocain to which a small amount of adrenalin had been added. The technique used was that described by Braun (6). One hundred cubic centimeters were injected for the splanchnic anæsthesia. In virtually all instances the anæsthesia was entirely satisfactory and free from untoward results excepting a transitory drop in blood pressure. The immediate postoperative effects were much better than in the patients operated upon under ether anæsthesia.

In Table III the four operative methods are listed so as to show which methods were employed in the various forms of ulcer. Three patients with gastric ulcer and four with duodenal ulcer had previously undergone gastroenterostomy.

TABLE III.—OPERATIVE METHODS

Operative method	Gastric ulcer	Duodenal ulcer	Gastric and duodenal ulcer	Jejunal ulcer	Total
Billroth I	77	56	10	7	150
Billroth I Haberer	1	52	2	4	59
Billroth II Antecolic	1	50	5	3	59
Billroth II Retrocolic	2	18	..	6	16
Total	81	166	17	20	284

The Billroth I method which is in vogue at Graz has been described by Orator (27). It is employed in every case in which there is sufficient serosa on the posterior wall of the first portion of the duodenum to insure a safe apposition of serous surfaces for the anastomosis. The stomach and duodenum are united end-to-end without closing the upper part of the cut end of the stomach as originally done by Billroth. This operation is unquestionably the most physiological of all types of gastric resection. It re-establishes the normal continuity of the gastro-intestinal tract and, as roentgen studies have shown, favors the develop-

ment of a new sphincter which apparently effects a rhythmic emptying of the stomach. The extent of the stomach removed varies from one-half to two-thirds of the organ. The anastomosis lies on the head of the pancreas either in the midline or slightly to the left of it, depending upon the length of the duodenum, the degree to which it is mobilized, and the amount of duodenum resected. Two layers of sutures are used for the anastomosis, a continuous lock stitch of catgut for the mucosa and interrupted silk sutures for the serosa. Unquestionably the operation is technically difficult and requires more skill and experience than other forms of resection. The technique can be mastered, however, by careful attention, particularly to the first layer of serosal sutures uniting the posterior wall of the stomach and duodenum.

The second method of choice is the Billroth I with a terminolateral anastomosis as described by Haberer (14) in 1922 and consists in the closure of the duodenal stump and the implantation of the cut end of the stomach in the side of the second part of the duodenum below the level of the papilla of Vater. It entails the mobilization of the duodenum according to the method described by Kocher (18) for the removal of calculi from the retroduodenal portion of the common bile duct. It is used in those cases of duodenal ulcer in which serosa is lacking on the posterior wall of the first portion of the duodenum. It unites the stomach directly with the most alkaline portion of the duodenum. The immediate postoperative course is characterized by a tendency to gaseous eructations and vomiting, but this usually subsides within a week. This type of operation as well as the typical Billroth I operation favors the development of a new sphincter control.

The Billroth II operation is reserved for those cases in which it is not feasible to perform a Billroth I. As shown in Table III, this group is comparatively small. The antecolic method supplemented by an entero-anastomosis between the afferent and efferent loops of the jejunum as described by Braun is preferred to the retrocolic method. The advantage of the antecolic method is that it prevents stasis in the duodenojejunal segment and also permits easier access to the gastrojejunal stoma in the event of the development of a jejunal ulcer.

MORTALITY

The question of operative mortality is to a great extent the crux of the whole problem as to whether gastroduodenal ulcer should be treated by gastro-enterostomy or by gastric resection and has undoubtedly been a great deterrent factor to the widespread adoption of gastric resection. In the two years from January 1, 1925, to January 1, 1927, all of the cases of gastroduodenal ulcer which were operated upon by Haberer at the Landeskrankenhaus were subjected to gastric resection. In other words the group of patients under consideration represents a wholly unselected series, a fact which should be borne in mind in interpreting the mortality statistics. The total mortality for the two years was 8.4 per cent. There were 9 deaths in 1925 with a percentage of 6.4, as compared with 15 deaths in 1926 with a percentage of 10. The increase of deaths in 1926 was due to the occurrence of 5 deaths in December from pulmonary complications which resulted from a severe epidemic of grippe. An analysis of the mortality of the various types of resection is given in Table IV.

TABLE IV.—MORTALITY FOLLOWING RESECTION

Type of operation	No. of cases	Deaths	Per cent
Billroth I	150	9	6
Billroth I Haberer	59	6	10
Billroth II Antecolic	59	6	10
Billroth II Retrocolic	16	3	18
	284	24	8.4

Necropsies were performed in all but 3 cases. As the clinical picture was sufficiently clear-cut to establish the cause of death, these 3 cases will be included in the analysis given in Table V. All cases presented a varying degree of bronchopneumonia of the lower lobes,

TABLE V.—CAUSE OF DEATH

	No. of cases
Pneumonia	7
Peritonitis	4
Abscess (subphrenic or retroperitoneal)	8
Myocarditis	3
Ileus	1
Ligation of the duct of Wirsung	1
Total	24

but only those patients in whom the abdominal findings were completely negative, are listed as having died of pneumonia.

FOLLOW-UP RESULTS

In conducting the follow-up a card was sent to each patient who had been operated upon, requesting him either to report at the out-patient department or to answer in writing as to the state of his health. Of the 257 patients to whom cards were sent, 40 had moved and could not be traced and 38 failed to reply. In other words follow-up results were obtained from 179 patients. As this was the first attempt at systematic follow-up, it was to be expected that a considerable number of cases would not be located.

The results have been divided into three groups, i.e., excellent, fair, and poor. The patients who were completely free from preoperative symptoms were put in the first class. Those who stated that they were greatly improved, but still had occasional symptoms were classed as having a fair result. Those who developed jejunal ulcers or else reported that they were no better than before the operation, were considered to be poor.

Of the 54 patients who were operated upon for gastric ulcer and from whom replies were obtained, 45 were found to be in excellent health. The majority of these patients had gained over 15 pounds in weight; 12 had gained over 25 pounds, and 5 had gained over 40 pounds. These patients unanimously praised the successful outcome of the operation and stated that they had never felt better and that they were able to conduct their daily duties in a perfectly normal manner. They were able to eat everything without restrictions and could even drink beer and wine without gastric distress. The 9 patients who were classed as having fair results complained chiefly of distress after drinking milk or eating sweet foods. Others were unable to eat a heavy meal without a sense of discomfort and weakness. These latter symptoms are undoubtedly due to the reduced size of the stomach, so-called microgastria, but the inability to tolerate milk and sweet foodstuffs cannot be so readily explained. There were no instances of jejunal or recurrent ulcer. At this point, it is desirable to recall that of the 81 cases of gastric ulcer, 77 were operated upon according to the Billroth I method.

The results of gastric resection for duodenal ulcer are probably of greater interest than the statistics for gastric ulcer, because duodenal ulcer is considered the most satisfactory indication for gastro-enterostomy by the advocates of this operation. Replies were obtained from 107 cases. Three patients had died of intercurrent disease. Of the remainder 83 were classed as excellent, 16 as fair, and 5 as poor. It is not necessary to report on the first group further than to say that they were completely symptom-free. The average gain in weight was not as great as in the class of gastric ulcer patients who had reported similarly good results. Although there were 2 patients who had gained 55 and 60 pounds, respectively, the majority of patients gained only between 5 and 15 pounds. The patients who had fair results complained mainly of indisposition after eating certain foods or after a heavy meal. Of the 5 patients who had poor results, 2 developed gastrojejunal ulcers.

CASE REPORTS

The first patient was a man, aged 42, upon whom an antecolic Billroth II resection was performed on February 4, 1925. He was symptom-free for 4 months and then developed periodic epigastric pains, which gradually increased in intensity. He was readmitted to the hospital on April 20, 1926. Gastric analysis showed a free acidity of 4 and a total acidity of 14. Roentgen examination showed a niche opposite the gastro-enterostomy stoma and this was confirmed at operation on April 24, 1926, when a jejunal ulcer was found along the mesenterial border of the jejunum at the point visualized roentgenologically.

The second patient, a man of 51, gave a history of periodic gastric pains of 30 years' duration. A gastro-enterostomy, performed in 1904, was followed by 6 years of relief. At operation on February 7, 1925, an ulcer of the superior border of the first part of the duodenum was found. In spite of the fact that the gastro-enterostomy stoma showed moderate inflammatory changes, a Billroth II was performed, the previous gastro-enterostomy stoma being used. Following operation the patient was free from all symptoms for one year and gained 45 pounds in weight. At the end of that time he suddenly developed pains, heartburn, and shortly thereafter melæna. At operation on December 29, 1926, a jejunal ulcer was found along the mesenterial border of the jejunum opposite the gastro-enterostomy stoma. On account of the former operative findings, it is reasonable to

assume that this ulcer was simply the extension of previous pathological changes.

The third patient was a man of 45 who had had gastric disturbance for 5 years. At operation on January 22, 1926, an ulcer of the anterior and posterior wall of the first part of the duodenum was found. A Billroth I with a terminolateral anastomosis was performed. The postoperative course was complicated by persistent vomiting which lasted for 6 weeks. Ten months later the patient was readmitted with a history of pain and vomiting of 4 months' duration. The roentgen examination was negative; the gastric analysis showed a total absence of free hydrochloric acid; the blood Wassermann was negative. At a second operation on December 17, 1926, many adhesions were found between the stomach and the anterior abdominal wall, but the anastomosis was large and normal in every way. The adhesions were divided and the abdomen was closed. Following the operation the patient continued to vomit in small amounts almost daily. Roentgen examination was repeated with negative findings. The neurologist, who saw the patient in consultation, was of the opinion that the patient's symptoms were functional in origin and the expression of an anxiety neurosis. In January, 1928, the patient reported by letter that he was still suffering from gastric symptoms with nausea and vomiting.

The two remaining patients who had poor results following operation, were likewise neurasthenic individuals. One of them had been operated upon previously and a gastro-enterostomy performed. At re-operation a superficial ulcer of the anterior wall of the first portion of the duodenum was found and a Billroth I resection gave only temporary relief.

Follow-up results were obtained from 10 patients in whom both gastric and duodenal ulcers were found at operation. These results were uniformly excellent.

As shown in Table III, there were 20 operations performed for jejunal ulcer. One patient was operated upon 3 times for recurrent jejunal ulcer and a second patient twice. These cases have been reported fully by von Haberer (15). In this series of 17 cases, there were 3 deaths. As 5 patients could not be located and 1 patient failed to reply, the results can only be given on 8 patients. Of these patients 6 reported that they were in excellent health and completely sypmtom-free. One patient developed pain 6 months after operation and the findings of roentgen examination were suggestive of the presence of a jejunal ulcer. The other patient developed sudden hæmatemesis 7 months after operation, but as he was also suffering from hepatic cirrhosis, the bleeding may have been due to œsophageal varices.

TABLE VI.—RESULTS OF OPERATION

	No. of replies	Excellent	Fair	Poor
Gastric ulcer	54	45	9	0
Duodenal ulcer	107	83	16	5
Gastric and duodenal ulcer	10	10	0	0
Jejunal ulcer	8	6	1	1
Total	179			

CONCLUSIONS

The Billroth I method of gastric resection is recommended as the operation of choice for the surgical treatment of gastroduodenal ulcer unless technical difficulties prevent its use. In a series of 150 cases there was no instance of recurrent or jejunal ulcer, thus confirming the opinion of von Haberer on the basis of a larger series of 1200 cases. It is believed that the reported recurrences after Billroth I resections are due to the fact that an ulcer of the posterior wall has been overlooked or else to the establishing an anastomosis in an inflamed area of stomach or duodenum.

There was one instance of jejunal ulcer in a series of 75 Billroth II resections.

The follow-up results after resections for gastroduodenal ulcer show that 96 per cent of the patients were completely symptom-free or tremendously improved.

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THE RELATION OF THE HISTOLOGICAL STRUCTURE TO THE PROGNOSIS OF THE CARCINOMATA OF THE UTERINE CERVIX

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IN recent years definite relations between the histological structure and the prognosis of carcinomata have been established through the methodical investigations of several workers. The pioneering work was performed by Broders (3–7), who divided the carcinomata of the skin into four groups according to their degree of differentiation and found a definite relationship existing between this scale of histological malignancy and the percentages of cures obtained in the different groups. He also extended his studies to carcinomata of various organs and obtained similar results.

Martzloff (23) classified the primary solid carcinomata of the uterine cervix into three groups according to the predominating cell type present (spindle cell, transitional cell, and spinous cell) and reported that the percentages of cures increase with the maturity of the type of carcinoma. Greenough (13), who studied the carcinomata of the breast, divided these tumors into three groups according to the degree of differentiation and anaplasia and also stated the existence of definite relations between the histological structure and prognosis of the carcinomata of the breast. In communications of Lahm (20), Cordua (8), Regaud (30), and others similar statements are made confirming these findings. While these workers restricted their investigations to a study of the structural and cellular condition of the parenchyma of the tumor, McCarty (24) examined the relation of the stroma to the prognosis. From a study of the carcinomata of the stomach he concluded that the life expectancy is increased when the stroma is hyalinized or fibrotic and when it contains a marked lymphocytic infiltration.

In a previous paper (16) I described a method of determining histological malignancy of carcinomata of the uterine cervix by a numerical evaluation of 9 different factors recognized as characteristics of differentiation and anaplasia. In this system only histological features pertaining to the parenchyma were considered. Recently I have attempted to improve this method by increasing the number of factors from 9 to 20, including also those belonging to the stroma. The results of this study are contained in the present communication.

The list of the 20 factors considered is as follows: (1) special cell type of carcinoma, (2) nucleocytoplasmic coefficient, (3) number of "pencil cells," (4) infiltrative growth of cells, (5) general type of carcinoma, (6) irregularity in size of cells, (7) irregularity in shape of cells, (8) distinctness in outline of cells, (9) chromatism of cytoplasm, (10) functional activity of cells, (11) irregularity in size of

nuclei, (12) irregularity in shape of nuclei, (13) chromatism of nuclei, (14) hyperchromatism of nuclei, (15) number of mitoses and prophases, (16) irregularity of mitoses, (17) character of stroma, (18) vascularity of stroma, (19) type of cellular infiltration of stroma, and (20) amount of cellular infiltration of stroma.

DEFINITIONS AND TECHNIQUE

1. Special cell type of carcinoma. The carcinomata of the uterine cervix were classified according to their general structure and the maturity of the predominant cell type into two main groups, the glandular carcinomata and the primary solid carcinomata, and each of these was subdivided into four sub-groups.

A. Glandular carcinomata
   1. Malignant adenoma
   2. Papillary and gelatinous adenocarcinoma
   3. Adenocarcinoma simplex
   4. Solid adenocarcinoma

S. Primary solid carcinomata
   1. Spinous cell carcinoma with cornification
   2. Spinous cell carcinoma without cornification
   3. Round cell carcinoma
   4. Spindle cell carcinoma

Carcinomata of sub-groups 1 were evaluated with 2 points, those of sub-groups 2 with 4 points, those of sub-groups 3 with 6 points, and those of sub-groups 4 with 8 points.

2. Nucleocytoplasmic coefficient. The relative number of those carcinoma cells which showed a large nucleus surrounded by a small amount of cytoplasm was estimated. If 10 per cent or less of such cells were among the tumor cells 1 point was counted. Their presence in from 10 to 20 per cent was evaluated with 2 points, in from 20 to 30 per cent with 3 points, and in more than 30 per cent with 4 points.

3. Number of "pencil-cells," "Pencil-cells," described by Lahm (20) as slender cells with dark stained nuclei invading and destroying the carcinoma cells, were counted with 1 point when they were very numerous. Two points were evaluated when they were present in moderate number, 3 points when they were scanty, and 4 points when they were completely absent.

4. Infiltrative growth of cells. The presence of well defined outlines in the majority of the carcinomatous cell nests was evaluated with 1 point, diffuse invasion present in from 25 to 50 per cent of the cell strands with 2 points, in from 50 to 75 per cent with 3, and in more than 75 per cent with 4 points.

5. General type of carcinoma. If 75 per cent or more of the carcinoma was composed of parenchyma and if 25 per cent or less was stroma, 4 points were counted; if from 50 to 75 per cent was parenchyma and from 25 to 50 per cent was stroma 3 points were evaluated; if from 25 to 50 per cent was parenchyma and from 50 to 75 per cent was stroma, 2 points; and if 25 per cent or less was parenchyma and 75 per cent or more was stroma, 1 point was counted.

6 and 7. Irregularity in size and shape of cells. The average size and shape of the tumor cells were studied. Deviations from this size and shape, respectively, in from 40 to 50 per cent of the cells was evaluated with 4 points, in from 30 to 40 per cent with 3 points, in from 20 to 30 per cent with 2 points, and in less than 20 per cent with 1 point.

8. Distinctness in outline of cells. Distinct outlines present in 75 per cent or more of the tumor cells were evaluated with 1 point, in from 50 to 75 per cent with 2 points, in from 25 to 50 per cent with 3 points, and in less than 25 per cent with 4 points.

9. Chromatism of cytoplasm. If the majority of the carcinoma cells had an almost unstained cytoplasm, while the connective tissue cells were distinctly pink stained, 4 points were counted. If the cytoplasm was only slightly pink stained 3 points were evaluated; a moderately pink stained cytoplasm was given 2 points and a distinctly pink stained cytoplasm 1 point.

10. Functional activity of cells. Granules of keratin and droplets of mucous, respectively, present in less than 10 per cent of the tumor cells were evaluated with 4 points, functional activity present in from 10 to 20 per cent of the cells with 3, in from 20 to 30 per cent with 2, and in more than 30 per cent with 1 point.

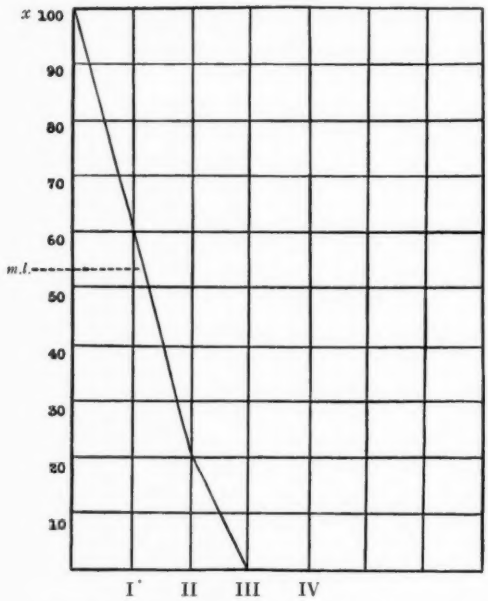

Fig. 1. Malignancy index and end-result. *x*, Percentages of end-result 1; *m.l.*, malignancy line.

11 and 12. Irregularity in size and shape of nuclei. The same viewpoints and percentages were used in the evaluation of this factor as described for 6 and 7.

13. Chromatism of nuclei. Four points were evaluated if the majority of the nuclei of the tumor cells had nuclei almost as distinctly stained as those of lymphocytes, 3 points if they were somewhat paler, 2 points if they were considerably fainter stained, and 1 point if they were very pale.

14. Hyperchromatism of nuclei. If 20 per cent or more of the nuclei were as dark stained as those of lymphocytes the factor was evaluated with 4 points, if from 15 to 20 per cent were hyperchromatic 3 points were counted, if from 10 to 15 per cent 2 points, and if such nuclei were present in less than 10 per cent 1 point was counted.

15. Number of mitoses and prophases. The mitotic figures and prophases in 10 fields (oil immersion, 1050 x magnification) were counted. Twenty or more mitoses and prophases were given 4 points; 15 to 19, 3; 10 to 14, 2; and 0 to 9, 1 point.

16. Irregularity of mitoses. Pathological types of mitoses present in less than 10 per cent of the mitotic figures were counted with 1 point, in from 10 to 20 per cent with 2 points, in from 20 to 30 per cent with 3 point, and in more than 30 per cent with 4 points.

17. Character of stroma. A very loose, œdematous connective tissue stroma was given 4 points, a moderately loose one 3, a fibrous one 2, and a fibrous one with extensive hyalinizations 1 point.

18. Vascularity of stroma. A highly vascular stroma was given 4 points, a moderately vascular one 3, a slightly vascular one 2, and one with very scanty vessels 1 point.

19. Type of cellular infiltration. A predominantly eosinophilic infiltration of the stroma was evaluated with 1 point, one mainly composed of lymphocytes mixed with some eosinophilic leucocytes 2 points, one consisting of lymphocytes, plasma cells, and scanty neutrophilic leucocytes 3 points, and one predominantly composed of neutrophilic leucocytes 4 points.

20. Amount of cellular infiltration. A dense cellular infiltration of the stroma was evaluated with 1 point, a moderately dense one with 2 points, a slight one with 3 points, and a very scanty one with 4 points.

RESULTS OF STUDY

The number of histological malignancy indices determined was 228 belonging to 226 different excisions. Two excisions each contained two carcinomata belonging to different main groups. The patients from whom these tissues were removed were admitted during the years 1922 to 1927 inclusive. In Table I the 228 malignancy indices are shown from a pathological viewpoint.

MALIGNANCY INDEX AND END-RESULTS

The clinical value of the malignancy index was tested by a comparison of the malignancy index with the end-result. The clinical end-results were graded by Schmitz (16) in the following manner: end-result 1 when the patient was free of symptoms and showed anatomical healing 3 years after the beginning of treatment, end-result 2 when the patient lived for 2 or 3 years after the begin-

TABLE I.—MALIGNANCY INDICES IN 228 CARCINOMATA*

Cell type	Average malignancy index	Range	Number of cases
A2	42.5	40–45	2
A4	50.7	43–61	10
A6	53.7	47–64	24
A8	62.8	47–79	25
S2	49.6	39–62	8
S4	50.8	34–70	52
S6	58.1	41–73	83
S8	65.7	45–76	25
A2 and S2	46.05	39–62	10
A4 and S4	50.75	34–70	62
A6 and S6	55.90	41–73	107
A8 and S8	64.25	45–79	50

*Cell types designated by the letter A represent glandular carcinomata and those by the letter S primary solid carcinomata. The numbers represent the numerical evaluation of the subgroups and are used as abbreviations of their names.

ning of treatment, end-result 3 when the patient lived for 1 or 2 years after the treatment was started, and end-result 4 when the patient lived for a year. The end-results were known in 48 cases. From this group those cases were excluded in which the carcinoma was already generalized, that is, in which a frozen pelvis or distant metastases were present at the time treatment was started on account of the invariably infaust prognosis The 48 available cases were divided into 4 groups according to their malignancy index. The first group included carcinomata with a malignancy index ranging from 22 to 39, the second those from 40 to 54, the third those from 55 to 69, and the fourth those from 70 to 84. After determining the percentages of end-result 1 in the different groups the following relations were found. There was no case with a known end-result in the Group 1; in Group 2 with 13 cases an end-result 1 was obtained in 61.5 per cent; in Group 3 with 28 cases an end-result 1 was recorded in 28.5 per cent, and in Group 4 with 7 cases, an end-result 1 was not obtained in a single instance. The diagram in Figure 1 illustrates the relation between malignancy index and prognosis. The "malignancy line" follows the percentages of end-results of the four groups.

STROMA INDEX AND END-RESULTS

Studying the relation between the condition of the stroma and the end-result I evaluated the stroma from the standpoint of its

Endresult	I	II	III	IV	Number of Cases
1-3.5	15	6	4	1	26
3.6-9	3	4	5	10	22

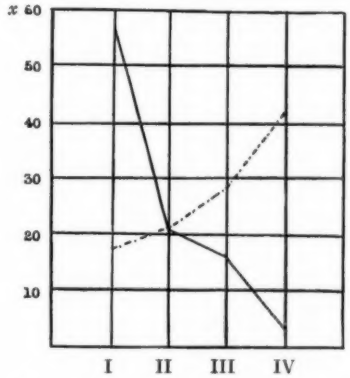

Fig. 2. Parenchyma-stroma coefficient and end-result. *x*, Percentages of cases;—, parenchyma-stroma coefficients from 1-3.5; --.--.--, parenchyma-stroma coefficients from 3.6-9.

antiblastic character. The resulting "stroma index" represents the sum of an evaluation of the factors 4, 5 and 17 to 20 of the malignogram. A hyalinized stroma was evaluated with 4 points, a fibrous one with 3, a moderately loose one with 2, and a loose one with 1 point. The total range of the stroma index is from 6 to 24. The average stroma index of the 17 cases with end-result 1 is 14.8, ranging from 11 to 21; the average stroma index of cases with end-results 2, 3, and 4 is 12.6 ranging from 8 to 18. The stroma index apparently shows a certain relation to the end-result.

PARENCHYMA-STROMA COEFFICIENT AND END-RESULTS

I also attempted to ascertain the relation between the blastic properties of the parenchyma and the antiblastic qualities of the stroma to the end-results. For this purpose I used a "parenchyma index," the sum of the evaluations of the factors 1 to 16 of the malignogram. The ratio of parenchyma index to stroma index represents the parenchyma-stroma coefficient. The parenchyma-stroma

coefficients thus obtained were divided into two groups, those between 1 and 3.5 and those between 3.6 and 9. From Figure 2 it is evident that the parenchyma-stroma coefficient is apt to be low in cases with good prognosis while it is in general high in cases with bad prognosis and rapid course of the disease.

MALIGNANCY INDEX AND PROGNOSIS

The prognosis of a carcinoma considered as the local manifestation of disturbances of general nature depends upon numerous factors of different character. They may be inherited or acquired, permanent or transient, local or general, varying in quality and intensity, affecting different organs and appearing at different times. They can be divided into four groups as follows:

1. The malignancy of the carcinoma represented by the infiltrative, destructive, and metabolic qualities of the tumor cells.

2. The endogenous blastic and antiblastic, local and general properties of the organism pertaining to race, sex, age, hereditary constitution, functional activity of the endocrine glands, tonus of the vegetative nervous system, condition of the reticulo-endothelial system, cellular, fermentative, and physical and chemical status of the blood, lymph and organs of the body, especially of the affected area.

3. Exogenous factors: (a) which contributed to the origin of the tumor (tar, paraffin, roentgen-rays, arsenic, bacterial and parasitic substances, and many others of chemical and physical nature). These factors may remain active during the course of the neoplasm or they may become inactive before the tumor becomes clinically manifest; and (b) which make their appearance after the tumor growth has become established as intercurrent diseases, changes in nutrition, environment, therapeutic procedures. They may exert a favorable or unfavorable influence upon the vital activities of the tumor and the blastic and antiblastic qualities of the host.

4. Secondary complications produced by the neoplasm of nonspecific nature: (a) Those of mechanical character as due to compression or obstruction of glandular ducts, ureter, intestine, œsophagus, etc. (b) Secondary infections of the tumor and the surrounding tissue which decrease the general resistance and prove sometimes fatal (mediastinitis in œsophageal carcinoma). (c) Resorption of toxic decomposition products from necroses of the tumor.

It is obvious from this compilation of the different factors that the histological malignancy index, in which only the potential malignancy of the carcinoma and the local antiblastic forces are evaluated, cannot give definite information about the future course of a single carcinoma. Such knowledge can only be obtained as the result of a consideration of all of the factors already mentioned and probably by others still unknown to us. Not before the histological malignancy index is supplemented by a "clinical malignancy index" we will be able to determine the prognosis of a carcinoma more accurately and reliably than we can do it at the present time.

HISTOLOGICAL STRUCTURE AND RADIOSENSITIVENESS

The detailed histological analysis of the carcinomata of the uterine cervix presented in this paper offered a good opportunity for the study of the correlations which might exist between the histological structure and the radiosensitiveness of these tumors. Withers (37) in a recent paper asked that the pathology should be interpreted into terms of radiosensitiveness and Lahm (20) stated that the radiologist wants information as to the growth tendency of the carcinoma and the defensive reaction of the surrounding tissue on which he may base his considerations in regard to technique and dosage. Regaud (30) noted that a detailed knowledge of the histological character of the tumor may frequently influence the therapeutic radiological technique.

Up to the present time the attempts made to establish these correlations have been so inconclusive and the results obtained by the different workers so divergent that no definite information has been obtained. Dautwitz (10) concluded from his investigations that histological structure and radiosensitiveness do not show any interdependency. Regaud (30) observed a decrease of radiosensitiveness

with increasing immaturity of the carcinomata, but could not find any relation between radiosensitiveness and the condition of the stroma. Cordua (8) saw considerable variations of the radiosensitiveness of inoperable carcinomata of the uterine cervix of the same histological type. He regarded adenocarcinomata as refractory and observed better primary results in carcinomata of a medullary type. Pleik (28) stated that middle ripe carcinomata containing many mitoses, growing in large alveoli and possessing a moderate amount of stroma reaction render the best results. Lenz (21) noted also that adenocarcinomata of the cervix were radioresistant. Recurrences occurred in almost all adenocarcinomata. Loeb (22), however, asserted that the apparent radioresistance of adenocarcinomata is caused by their location deep in the tissues where they are less accessible to the action of the rays, while they are actually more sensitive than spinous cell carcinomata. Lahm (20) reported that he excludes rapidly growing and immature carcinomata from treatment with roentgen rays. He stated further that plexiform carcinomata react well, while very vascular and medullary ones are not very sensitive to roentgen rays. Boehm and Zweifel (2) noted that carcinomata composed of cells with abundant cytoplasm, growing in narrow strands surrounded by young, proliferating connective tissue with inflammatory reaction and eosinophilic infiltration, give the best results, while carcinomata growing in broad columns, surrounded by a resting stroma, are less susceptible to the action of roentgen rays. They do not recognize the law of Bergonié, that unripe and rapidly growing carcinomata are more sensitive than ripe and slowly growing ones, as correct and agree in this respect with Adler, Kehrer, Frankl, Lahm, and others. Withers (37) reported that carcinomata of a mature type containing many mitoses, hyperchromatic nuclei, a marked functional activity, and a very vascular and loose connective tissue stroma are more radiosensitive than those tumors in which all or some of these features are absent. Cramer (9) also observed better results in carcinomata with a hyperæmic stroma than in those with an anæmic one. Adler (1) saw better roentgen-ray effects in mature carcinomata than in those of an immature type. Pemberton (27), however, asserted that the cell type is insignificant for the radiosensitiveness and that the parenchyma-stroma relation is important in this respect. He in turn is contradicted by Alter who stated that the radiosensitiveness decreases with the increasing maturity of the carcinoma, an assertion, which puts him into a juxtaposition to Regaud (30) and Schmitz (33). Roussy and Leroux (31) and Rubens-Duval (32) stressed the importance of the condition of the stroma for the radiosensitiveness of the carcinoma. The karyokinetic index of Lacassagne and Monrod is not considered as indicative of the radiosensitiveness of a carcinoma by most authors, including Minoflet and Schrumpf-Pierrou (25), Roussy, Laborde and Leroux (31), Regaud (30), Proust, Delbet (16), and many others.

From this incomplete compilation of references of the literature the existing discrepancies of opinions are evident. Several factors are responsible for this fact, for instance:

1. Variations in the interpretation and evaluation of the histological structure of carcinomata by the different investigators.

2. Varying consideration of the clinical aspect as extension, location, and macroscopical appearance of the carcinoma.

3. Insufficient consideration of the differences existing in the general condition of the patient as represented by age, state of nutrition, etc.

4. Differences in the radiological technique and dosage used by the different workers. The effects produced by the roentgen rays may be divided into three groups according to the parts affected.

A. Effect on the carcinoma cells.

1. Direct photochemical action. (a) Diffuse cytocaustic action, producing acute cellular necrosis. (b) Selective cytolethal and cytoregressive action. The cytoplasm shows swelling, œdema, clumping, disappearance of the plasmosomes, vacuolation and fatty degeneration. The nucleus presents increased irregularity and indistinctness in outline, hyperchromatism, and lysis. Disturbance of the mitotic process evidenced by the appearance

TABLE II.—HISTOLOGICAL

A. Special cellular and structural characteristics of carcinoma	Points 6–24	I				II				III				IV					
		1173	1474 Interval 10 mo.	Increase	Decrease	1318	1741 Interval 10 mo.	Increase	Decrease	1336	1354 Interval 1 mo.	Increase	Decrease	1397	1428 Interval 1 mo.	Increase	Decrease	1502 Interval 2 mo.	Increase	Decrease
1. Special cell type of carcinoma	2–8	6	6			6	6			6	6			8	8			6		2
2. Nucleocytoplasmic coefficient	1–4	1	1			4	2		2	1	1			3	4	1		3		1
3. Number of "pencil cells"	1–4	4	4			1	4	3		3	1		2	4	1		3	2	1	
4. Infiltrative growth of carcinoma	1–4	1	3	2		4	4			2	1		1	4	4			1		3
5. General type of carcinoma	1–4	4	4			4	2		2	2	3	1		3	3			3		
B. Characteristics of cytoplasm	5–20																			
6. Irregularity in size of cells	1–4	3	2		1	1	2	1		4	3		1	4	4			4		
7. Irregularity in shape of cells	1–4	2	3	1		1	4	3		4	2		2	4	4			4		
8. Distinctness in outline of cells	1–4	2	4	2		4	3		1	4	4			4	4			3		1
9. Chromatism of cytoplasm	1–4	1	2	1		4	1		3	2	1		1	1	3	2		2		1
10. Functional activity of cells	1–4	4	4			4	4			3	1		2	4	4			4		
C. Characteristics of nuclei	6–24																			
11. Irregularity in size of nuclei	1–4	4	3		1	2	2			4	1		3	4	4			4		
12. Irregularity in shape of nuclei	1–4	3	4	1		1	4	3		4	3		2	4	4			4		
13. Chromatism of nuclei	1–4	2	4	2		4	3		1	3	2		1	3	3			3		
14. Hyperchromatism of nuclei	1–4	4	4			1	3	2		4	1		3	4	4			2		2
15. Number of mitoses and prophases	1–4	3	3			4	1		3	2	1		1	3	4	1		4		
16. Irregularity of mitoses	1–4	1	4	3		4	1		3	3	1		2	4	4			4		
D. Characteristics of stroma	4–16																			
17. Character of stroma	1–4	3	4	1		2	1		1	4	2		2	3	2		1	4	2	
18. Vascularity of stroma	1–4	4	2		2	3	2		1	4	3		1	2	3	1		3		
19. Type of cellular infiltration	1–4	3	3			2	3	1		3	3			3	2		1	3	1	
20. Amount of cellular infiltration	1–4	2	2			2	3	1		3	4	1		1	2	1		3	1	
Histological malignancy index		57	66	13	4	58	55	14	17	66	44	2	24	70	71	6	5	66	5	10
Clinical group		3	3			3	3			4	4			2	2			2		
End-result		2	2			1	1			4	4			4	4			4		

of "Broeckelmitoses," slowing of the mitotic process resulting in congestion of mitoses in the first days following the irradiation, and subsequent decrease of the number of the mitotic figures represent the effect upon the proliferative cellular qualities. These degenerative changes of the tumor cells are either followed by death of the cells or they represent only a transient stage of lowered vitality from which they may recover if they are not destroyed in this stage by the attack of the defensive forces of the body. Besides these

MALIGNOGRAM OF TEN CASES

V				VI				VII				VIII				IX				X			
1304	1466 Interval 3 mo.	Increase	Decrease	1354	1356 Interval 1 wk.	Increase	Decrease	1652	1667 Interval 2 wks.	Increase	Decrease	1639	1674 Interval 1 mo.	Increase	Decrease	1813	2451 Interval 14 mo.	Increase	Decrease	2753	2854 Interval 2 mo.	Increase	Decrease
4	6	2		4	4			4	4			4	4			6	8	2		4	4		
4	4			1	2	1		1	1			4	2		2	4	1		3	4	2		2
4	3		1	3	1		2	3	2		1	4	4			1	3	2		3	3		
4	4			2	4	2		4	4			4	4			1	1			1	1		1
4	4			4	4			4	2		2	4	4			2	1		1	2	1		
4	3		1	4	4			2	1		1	4	3		1	2	1		1	2	2		
4	4			4	4			2	1		1	4	3		1	2	2			2	2		
4	4			1	1			1	1			1	1			4	3		1	1	1		
2	4	2		2	1		1	1	1			1	1			1	1			2	1		
3	4	1		3	1		2	1	2	1		4	1		3	4	4			1	1		1
4	2		2	2	4	2		3	3			4	4			3	1		2	2	1		1
4	4			4	4			3	1		2	4	4			4	2		2	1	2	1	
4	4			2	3	1		2	1		1	4	4			3	4	1		2	1		1
4	4			2	1		1	3	3			4	4			1	4	3		4	2		2
4	2		2	3	3			4	1		3	4	1		3	2	1		1	1	1		
4	1		3	2	4	2		4	1		3	1	4	3		3	1		2	1	1		
1	4	3		4	4			4	2		2	4	4			2	1		1	2	1		1
1	3	2		3	3			4	3		1	4	3		1	3	1		2	3	3		
3	2		1	3	3			4	3		1	4	4			3	3			3	3		
4	3		1	3	3			2	2			1	3	2		2	2			2	4	2	
70	69	10	11	56	58	8	6	56	39	1	18	68	62	5	11	53	45	8	16	43	37	3	9
R3	R3			3	3			4	4			4	4			3	3			4	4		
4	4			2	2							4	4			1	1						

renitent tumor cells there may also exist refractory cells. Waetgen (36) saw after intensive treatment well preserved carcinoma cells and Seidemann (34) reported the presence of carcinomata which had a perfectly normal appearance in the crater formed by the vaginal radiation employed in a case of cervical carcinoma.

2. Secondary effects. (a) Modification of growth by increase of the degree of differentiation and stimulation of the functional activity. A basal cell carcinoma may for

instance change into a spinous cell carcinoma, a spinous cell carcinoma into one with cornifications, an adenocarcinoma simplex into a gelatinous adenocarcinoma, etc. (b) Retardation of growth due to the impairment of the proliferative qualities of the tumor cells. (c) Stimulation of growth in refractory parts of the tumor evidenced by the increase of the histological malignancy or caused by a breakdown of the local or general resistance due to too intensive irradiation. This becomes manifest usually in from 6 to 8 weeks after the treatment.

B. Effect on the stroma.

1. Primary effects. They precede the changes taking place in the parenchyma (Opitz, 26). (a) Hyperæmia and œdema due to paresis of the vessel wall. (b) Proliferation of fibroblasts, histocytes, and capillaries. (c) Increase of the leucocytic and lymphocytic infiltration. A marked primary stroma reaction is regarded as a favorable sign (Quick and Cutler, 29).

2. Secondary effects. (a) Fibrosis and hyalinization of the increased connective tissue stroma. It surrounds the remaining carcinoma cells with a fibrous barrier. An actual choking of the tumor cells by the stroma, as asserted by some authors (Opitz, 26; Fraenkel, 12; Teilhaber, 35, etc.) and denied by others (Hamperl and Schwarz, 14; etc.) seems to be improbable because the tumor cells recover from the effect of the radiation more quickly than the cells of the stroma. (b) Obliteration of the vessels of the stroma after thickening of the vessel wall. In recurrences a decrease of the cellular reaction and a loosening and decrease of the connective tissue stroma may be observed (Hamperl and Schwarz). Recurrences originating from encapsulated tumor cells will occur if either the malignancy of the carcinoma cells increases or the local and general resistance decreases due to changes of endogenous or exogenous factors.

C. Effect on the organism in general. (a) Changes in the blood. They depend upon the extent and vascularity of the radiated area. There are changes in the number and ratio of leucocytes and lymphocytes, changes in the physical qualities of the blood (sedimentation time, coagulation time, surface tension, etc.), changes in the chemical composition of the blood (calcium and potassium, cholesterol and lecithin, etc.), and changes in the ferment content of the blood (lipolytic and carcinolytic ferments). (b) Changes in the activity of the endocrine glands. (c) Changes in the tonus of the vegetative nervous system. (d) Changes in the status of the reticulo-endothelial system. (e) Changes produced by the resorption of toxic decomposition products of the radiated tissue.

Ten cases with two or more sections removed during the course of treatment were available for a study and the effects of roentgen rays upon the different histological factors of the malignogram and of the interrelation between radiosensitiveness, malignancy index, and end-result are shown in Table II.

Among the 20 factors of the malignogram only 8 showed in the majority of the cases a deviation from their original value toward one side. The nucleocytoplasmic coefficient was increased after the roentgen-ray treatment in 2 cases and decreased in 5. The ratio in points between these two groups was 2:10. The irregularity in size of cells was increased in 1 case and decreased in 6 cases (ratio 1:6). The functional activity of cells was increased in 2 cases and decreased in 4 (ratio 2:8). Irregularity in size of nuclei was increased in 1 case and decreased in 5 cases (ratio 2:9). The number of mitoses was increased in 1 case and decreased in 6 cases (ratio 1:13). The character of the stroma was increased in 3 and decreased in 6 cases (ratio 6:8). The vascularity of the stroma was increased in 2 and decreased in 6 cases (ratio 3:8). The amount of cellular infiltration was increased in 6 cases and decreased in 1 case (ratio 8:1).

The average decrease in points of the 2 carcinomata with malignancy indices between 40 and 54 was 7 points, that of 6 carcinomata with malignancy indices between 55 and 69 was 5.5 points, and that of 3 carcinomata with malignancy indices between 70 and 84 was 1.7 point.

The average decrease in sections removed in the first month after the beginning of the treatment was 8 points, that of sections

removed in the second month 5 points, that of sections removed in the third to tenth month −1.7 points.

The average decrease of the 2 cases that were cured was 5.5 points, while the average increase of the 4 fatal cases was 0.25 points.

SUMMARY AND CONCLUSIONS

1. A report has been given of a method of numerical evaluation of histological malignancy freed to a large extent from the influence of individual interpretation by the introduction of 20 different factors representing histological qualities of the parenchyma and the stroma of carcinomata.

2. The sum of the evaluations or the "histological malignancy index" possesses a definite relationship to the end-result.

3. The "stroma index" or the sum of evaluations pertaining to the antiblastic qualities of the stroma was in general higher in cases with end-result 1 than in those with end-result 2, 3, and 4, dying in the first 3 years after the onset of treatment.

4. The "parenchyma-stroma coefficient" showed a definite relation to the duration of the disease.

5. Definite information concerning the course of a carcinoma depends on numerous local and general, endogenous and exogenous factors. The "histological malignancy index" in which only the histological evidence of the malignancy of the tumor cells and the local reaction of the organism is considered can therefore render an approximate estimation of the future course of the disease.

6. Radiosensitiveness of a carcinoma decreases with an increase of the malignancy index.

7. A malignancy index which remains stationary or shows only minor variations from the value obtained before the beginning of the roentgen-ray treatment points to the presence of a radiorefractory carcinoma, while a marked drop of the value of the malignancy index after radiation is apparently indicative of a good radiosensitiveness of the tumor.

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AN EXPERIMENTAL STUDY OF MUSCLE ATROPHY

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THERE still remains some conflict of opinion regarding the mechanism of acute muscle atrophy following arthritis and trauma. Most of the standard textbooks of medicine, neurology, and pathology dismiss the subject with a reference to the speed with which atrophy can appear after acute arthritis. (McCallum, Aschoff, Tilney and Riley, Sachs, and Hausman.)

French, in his *Index of Differential Diagnosis*, 1921, states: "The atrophy is sometimes so rapid that some think it cannot be due simply to disuse but must have a neuropathic factor also."

In Rost's *Pathological Anatomy of Surgical Diseases*, 1923, there is a brief chronological account in which the author states that the widest acceptance has been won by the reflex theory of Brown-Séquard. However, he mentions later experimental results, incompatible with this theory, and concludes that the problem is still unsolved.

Dana's *Textbook of Nervous Diseases* has the following to say: "In inflammations of joints, the muscles moving them are affected by a simple atrophy which is called arthritic. The atrophy is probably due in part to disuse and, in part, it is a reflex trophic disturbance."

In the *Orthopedic Surgery* of Jones and Lovett it is stated that in every synovitis there occurs early an atrophy of muscle which is an essential part of the affection and not a complication. The same condition occurs after fixation of a limb and at times in connection with an injury to a limb not accompanied by frank synovitis and accompanies chronic joint disease as an integral part of the affection.

The study here presented was undertaken at the suggestion of Dr. P. W. Nathan to determine more accurately the relative speed and extent of the various types of acute, secondary muscle atrophy, in the hope that the results would cast some further light on the mechanism, especially, of the arthrogenic type.

Although the mechanism remains unexplained, acute atrophy following arthritis has been recognized since Hippocrates. Before the work of John Hunter, 1835, it was generally assumed that disuse of the affected limb was the factor that caused the atrophy. John Hunter wrote: "The lesions that involve the ligaments, the tendons, and the aponeuroses, particularly those due to sprain (trauma) disturb the functions of the muscles to a greater degree than those that involve the muscles themselves, in that such lesions, *by sympathy*, cause atrophy and loss of vigor."

Brown-Séquard, in 1860, first suggested a reflex mechanism. He believed that the efferent vasomotor nerves were stimulated by the irritation of the arthritis, with consequent vasospasm that caused faulty muscle nutrition.

Thirteen years later, Vulpian attempted to prove this by artificially stimulating the efferent nerves. He was unable to demonstrate significant nervous control of the muscle vessels by this means and concluded that the reflex mechanism causing muscle atrophy was not that proposed by Brown-Séquard. He then suggested another reflex theory, viz., the irritative joint lesion sends afferent impulses to the muscular trophic centers in the cord; and the stimulation of these centers causes the muscle to atrophy. This theory was almost simultaneously enunciated by Paget.

Numerous other theories were suggested at approximately the same time. Sabourin, in 1873, announced an elaborate one, based on direct extension of the pathological process. He believed that the inflammation proceeded from the joint peripherally to the fibrous muscle sheath, thence to the neurolemma, the nerve, the nerve ending and finally, the muscle. As late as 1888 Struempell, on the basis of microscopic findings, believed that the atrophy was due to the extension of the inflammatory process in the joints to the muscles. The inadequacy of these theories was more or less conclusively demonstrated by

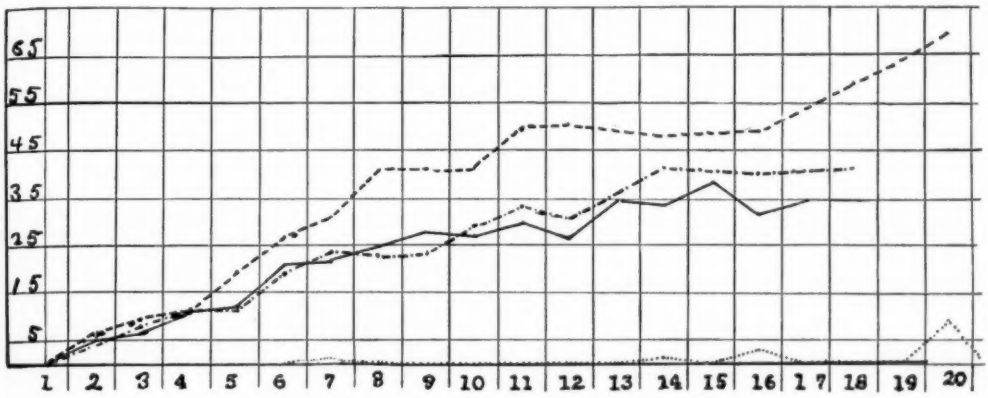

Fig. 1. Progress in atrophy following immobilization, ...; arthritis, —; nerve section, --; tenotomy, ---.

Duplay and Cazin in 1893. These authors microscopically studied the atrophic muscles as well as the nerves and neurolemma and could find no evidence of inflammatory change. It is not to be denied that acute inflammatory arthritic processes may extend beyond the joint. However, the fact that acute atrophy does occur in the absence of such extension is sufficient evidence to show that the extension does not cause it. Also, the theories depending on direct extension do not account for the atrophy occurring after aseptic joint lesions, which certainly do not spread to surrounding tissues.

In 1877 the first effort to reproduce arthrogenic atrophy in animals was published by Valtat. He produced arthritis in the knees and shoulders of guinea pigs and dogs by traumatizing the joint and by the use of irritating substances. The animals were killed at varying periods thereafter and marked atrophy of the musculature about the joint was found.

Valtat's methods were crude; the muscles were weighed wet and his procedure of weighing entire extremities is a most difficult one to carry out accurately. Nevertheless his work sufficed to demonstrate that acute arthrogenic atrophy occurs in animals, and to give some idea of its extent and speed.

Valtat initiated an era of concentration on the subject in France, and in 1890 Raymond and Deroche announced that their experiments had proved the reflex theory to be correct. Raymond produced arthritis in the knees of dogs and cats by cauterization and the introduction of silver nitrate. The animals were killed at varying periods following the injection and the rectus femoris muscle of the arthritic extremity was weighed. The same muscle on the opposite extremity served as a control. He confirmed Valtat's experiments.

In a second group of two animals, arthritis was produced in both hind limbs after unilateral section of the posterior spinal roots from the third dorsal to the third sacral segment. The weight of the rectus femoris muscle on the side of the cut roots was much greater than the other side. In fact, the weight ratio was similar to that in the first group of experiments. From these experiments it was concluded that the reflex path was essential for the production of acute atrophy. Deroche duplicated and confirmed Raymond's work.

At approximately the same time Hoffa became interested in the problem. It was his first belief that the pathological joint effusion was absorbed through the lymph channels, by which route it came into contact with and affected the extensor muscle groups. He tried experimentally to demonstrate the anatomical plausibility of this by injecting the knee joints with colored substances that could later be recognized in the musculature. His experiments showed the substance only in the deeper muscles (vasti). None could be demonstrated in the rectus femoris, a muscle that had been

shown to atrophy after knee joint inflammations. Hoffa then, in 1908, repeated Raymond and Deroche's work and confirmed their conclusions in every particular.

While Hoffa was still engaged in this work, Sulzer, in a paper published in 1897, maintained that arthritic atrophy could be accounted for by inactivity alone. He showed that the muscles spanning ankylosed joints were atrophic as compared with those of the normal leg. He also showed that muscles spanning two joints (recti), one ankylosed and one normal, were less atrophic than muscles with completely fixed origins and insertions (vasti). This work was done chiefly on cases of chronic arthritis. Sulzer concluded, then, that fixation can produce atrophy. His work, however, does not prove that it can be produced in the short time in which arthrogenic atrophy may appear.

Bum, a pupil of Sulzer, attempted, in 1906, to obtain experimental evidence for Sulzer's point of view. Bum injected the hip joint of a rabbit with an irritating solution and splinted the opposite side. The animal was killed in a few days and the muscle weights were measured. The atrophy was more extensive on the splinted side. In a second rabbit Bum injected the knee joint of one side and splinted both extremities. Muscle weights after several days showed the atrophy to be equal on both sides, and, on this basis, Bum concluded that inactivity was responsible for the atrophy in both cases.

Schiff and Zak, in 1912, continued and elaborated Bum's experiments. They quoted the results of Hoffa, Raymond and Deroche, admitting the correctness of their observations but questioning their interpretation. They suggested that, in the experiments of these observers, atrophy is absent on the side of the sectioned posterior roots because pain sensation is absent and there is no consequent disuse. The cutting of the reflex path in itself does not prevent the atrophy but merely obviates pain which, when present, causes limitation of voluntary function.

Schiff and Zak employed both the wet and the dry methods of weighing in their experiments. They used chiefly the quadriceps group. One extremity of a guinea pig was immobilized in plaster and the muscles of both sides weighed on the seventh day. The results corresponded with Bum's experiments; marked atrophy was present on the immobilized side (quadriceps).

But complete inactivity does not always follow arthritis. Therefore a second experiment was undertaken to reproduce the effect of partial inactivity. The Achilles tendon of a series of guinea pigs was cut on one side. This, the authors felt, produced partial inactivity. After 7 to 9 days there was decided atrophy of the entire extremity.

In order to eliminate the possibility that a hypertrophy of the opposite leg accounted for the weight difference, a third study was undertaken. The Achilles tendons of both sides were cut in two dogs. On one side of each the knee joint was injected with turpentine. After a week the side with the turpentine arthritis and the severed tendon, showed only 4 per cent more atrophy than the side that had only the tendon severed. Schiff and Zak were satisfied that partial inactivity could produce the same degree of atrophy as knee joint arthritis, and that partial inactivity following a painful knee joint was responsible for the subsequent atrophy.

The work of these observers may be criticized from several aspects. In the first place, an insufficient number of animals was employed to insure accurate results. Our experiments have shown that many extraneous factors, such as plaster bruises and excoriations or even plaster pressure, with intact skin, may influence to a surprising degree the atrophy of the muscles of the extremities; this factor will be further considered in our immobilization experiments. Besides the factor of accuracy, there are several assumptions which, we believe, are unjustified. That external fixation or immobilization is equivalent to complete muscle inactivity certainly cannot be accepted by us. This will be fully discussed at a later period. Here it will suffice to say that a muscle immobilized cannot necessarily be considered as being in a state of complete inactivity.

Again, we may criticize the assumption that atrophy of the muscles following achillo-tenotomy is due solely to partial dis-

use. The possibility that a reflex mechanism is concerned cannot be so easily dismissed.

A further study was undertaken by Schiff and Zak, namely, a repetition of Hoffa's experiments (section of the lumbar and sacral nerve roots on both sides, with the production of inflammation of one knee joint). This experiment resulted, after several weeks, in only 1 to 5 per cent atrophy of the quadriceps on the affected side. A control animal, in which the posterior nerve roots were cut but the knee joint left intact, showed a similar small amount of atrophy, so that, in both cases the atrophy was attributed to inactivity by these observers.

In the fifth group of animals, the dorsal cord was sectioned and one knee joint injected. The animals were killed after 2 weeks and the leg muscles of the injected side were 6 to 12 per cent heavier. This finding is difficult to reconcile with the reflex theory, according to which the greater loss should be on the side of the inflamed knee joint.

Schiff and Zak explain that the cord section causes rapid atrophy of both legs; but the atrophy on the side of the joint inflammation is delayed by the stimulation of the lower motor neurone reflexes caused by the joint irritation. The assumption that the reflex arc preserves the musculature in this case does not imply a trophic factor. (These authors believed that the irritation of the musculature produced muscular contraction, and thereby prevented the inactivity.)

Legg, in 1908, reported a further study of muscle atrophy following arthritis. Three groups of three rabbits each were employed. In the first group one knee joint of each rabbit was inoculated with a suspension of viable tubercle bacilli. The same procedure was performed on the second group but, in addition, the leg was immobilized by means of a tin splint. In the third group, one leg was splinted but the knee joint not infected. The animals were all killed after 40 days and the rectus femoris was measured by the microscopic method (taking an average of the diameters of 300 fibers). His results showed that immobilization alone causes as much atrophy as immobilization plus infection (12 per cent). The group in which the knee joints were infected but not splinted showed less atrophy (7 per cent) than either of the other two groups. The atrophy produced by tubercle bacilli (7 per cent in 43 days) is of such small amount that we are not justified in calling it acute atrophy (turpentine atrophy reaches this degree in 2 days).

Legg attributes all these types of atrophy to reflex vasomotor impulses which cut down the blood supply to the affected part. We can, however, find no evidence for this view in the results of his experimental work. It will be remembered that Brown-Séquard held a similar view, but Vulpian failed to produce a marked degree of vasospasm by stimulating the efferent nerves. The possibility that such diminution of the blood supply could produce the extreme degree of atrophy that follows acute arthritis, certainly does not coincide with our clinical experience. (There is, for example, little or no atrophy following thrombo-angiitis obliterans of long standing.)

In 1926 Harding made an interesting contribution to the subject from a different aspect. Two parallel series of rabbits were employed, in one of which (14 in number) a knee joint arthritis was produced by the streptococcus infrequens. In the other series (6 in number), one extremity was immobilized in a plaster spica. After 3 weeks the femoral arterial and venous blood was drawn from the animal under anæsthesia and subjected to gas analysis to determine the oxygen consumption in the extremity. The animals were then killed and the quadriceps muscle group weighed, the opposite side being used as a control.

Harding's results showed practically a doubling of the oxygen consumption in the arthritic atrophy cases, whereas the immobilized animals showed only a slight increase above normal. Harding believed that this difference was due to a higher rate of muscle catabolism in arthritic atrophy than in immobilization; and that this indicated a different mechanism of production.

Further experimental work along these lines is certainly necessary before Harding's interpretation can be accepted. It is possible that the administration of an anæsthetic is a complicating factor. Again, it may be that any

spastic muscle will give evidence of as great an increase in oxygen consumption, regardless of its size diminution. In other words, no evidence is presented that the increased catabolism bears any direct relationship to the atrophy.

From this brief summary of the literature upon muscle atrophy, it is clear that there still exists a considerable diversity of opinion as regards the mechanism and cause of this condition. There are, moreover, rather remarkable differences in the results obtained in the experimental work undertaken to clear up the subject; and even where the results obtained by experiments are similar, the authors are at variance as to their interpretation.

For these reasons we decided to repeat the experimental work that has been done, in the hope that by taking great care to have the experimental methods accurate and the findings unequivocal, we might be able to clarify the subject.

One hundred and eighteen rabbits were used in the study.

The semitendinosus muscle was used for the first three groups of experiments. It was chosen because of the following reasons:

1. It is an auxiliary muscle and, therefore, its paralysis causes no discernible lameness or disability.

2. It is a red muscle—completely surrounded by the pale adductor magnus and it can be accurately dissected out.

3. It has a small and well defined origin and insertion which can be accurately dissected or sectioned.

4. It crosses the knee joint and will be affected by pathological processes in that joint.

5. The nerve supplying this muscle is single and can be sectioned by a posterior approach as it leaves the sciatic trunk, thus minimizing the possibility of injury to the blood supply of the muscle, to the muscle itself.

It was necessary to employ the gastrocnemius muscle for the fourth group (immobilization experiments). As the semitendinosus muscle takes its origin from the pelvis, in order to immobilize this muscle, it is necessary to immobilize the thigh on the pelvis. In the rabbit, it was found impossible to accomplish this unless the motion of the opposite lower extremity was restricted and this would preclude the use of the opposite member as a control. On the other hand, the gastrocnemius can be immobilized by means of a plaster spica without any effect upon the opposite extremity.

To determine the variation that might exist in normal muscles and to determine the more accurate method of weighing to be adopted, we dissected and weighed semitendinosus muscles in a series of ten rabbits that had not been operated upon. The muscles were weighed both wet and dry. For the dry weighing the muscles were washed in water and dried for 24 hours in a dry chamber, with a constant temperature of 100° centigrade.

By the wet method the average difference between the muscles of both limbs was 7 per cent; by dry weight there was a variation of 2 per cent. From these findings, as shown in Table I, we considered the dry method of weighing to be the more accurate and this method was, therefore, used in all the experiments (Table I).

TABLE I.—WEIGHTS OF THE DRIED SEMITENDINOSUS MUSCLES IN TEN NORMAL RABBITS, NOT OPERATED UPON

Rabbit	Right gms.	Left gms.	Difference	Per cent
1	.985	1.016	.031	2.3
2	.673	.692	.019	2.9
3	.497	.516	.019	3.8
4	.304	.308	.004	0.1
5	.547	.549	.002	0.1
6	.312	.292	.020	6.4
7	.338	.332	.006	0.1
8	.487	.467	.020	4.1
9	.389	.388	.001	0.0
10	.329	.322	.007	0.2

Maximum difference, 6.4 per cent; minimum difference, 0.0 per cent; average difference, 2.2 per cent. Right heavier, 5 times; left heavier, 5 times.

TECHNIQUE OF EXPERIMENTAL ARTHRITIS

Turpentine was used as the irritant. After iodinization of the skin overlying the knee joint, the turpentine was injected hypodermatically into the knee joint. For the animals that were to be killed before the third day after the injection, 0.75 cubic centimeter was used; 0.5 cubic centimeter was used in those killed on the third day; 0.2 cubic centimeter was used for all animals that were to live

TABLE II.—TURPENTINE ARTHRITIS

Number	Side infected	Duration of arthritis in days	Amount of turpentine c.cm.	Weight of right semitendinosus	Weight of left semitendinosus	Difference (loss of weight)	Atrophy, per cent	Average daily atrophy, per cent
1	Right	1	0.75	.348	.349	....	0	0
2	Left	2	0.75	.282	.269	.013	4	
3	Right	2	0.75	.265	.282	.017	6	5
4	Left	2	0.75	.275	.260	.015	5	
5	Right	3	0.5	.232	.232	.020	8	
6	Right	3	0.5	.242	.257	.015	6	6.6
7	Left	3	0.5	.383	.347	.036	9	
8	Right	4	0.2	.377	.417	.040	9.5	
9	Left	4	0.2	.397	.345	.052	13	10.6
10	Right	4	0.2	.320	.354	.034	10	
11	Right	5	0.2	.496	.561	.065	11	
12	Left	5	0.2	.858	.752	.102	12	12.2
13	Left	5	0.2	.397	.341	.056	14	
14	Right	6	0.2	.235	.321	.086	26	
15	Right	6	0.2	.256	.295	.039	13	21
16	Left	6	0.2	.338	.256	.082	24	
17	Left	7	0.2	.403	.312	.093	23	
18	Right	7	0.2	.275	.370	.095	24	22
19	Left	7	0.2	.517	.423	.094	18	
20	Right	8	0.2	.286	.384	.098	26	
21	Right	8	0.2	.355	.470	.115	25	25
22	Left	8	0.2	.345	.268	.076	23	
23	Left	9	0.2	.472	.315	.157	33	
24	Left	9	0.2	.287	.373	.086	23	28
25	Right	9	0.2	.235	.327	.092	28	
26	Left	10	0.2	.438	.293	.145	33	
27	Left	10	0.2	.386	.296	.090	24	27
28	Right	10	0.2	.274	.382	.108	23	
29	Left	11	0.2	.436	.305	.131	30	30
30	Left	12	0.2	.392	.295	.097	24	
31	Left	12	0.2	.374	.273	.106	27	26
32	Right	12	0.2	.288	.392	.104	28	
33	Right	13	0.2	.197	.290	.093	32	34.5
34	Left	13	0.2	.343	.217	.126	37	
35	Right	14	0.2	.420	.627	.207	33	33
36	Right	15	0.2	.310	.515	.205	38	38
37	Left	16	0.2	.260	.165	.095	37	
38	Right	16	0.2	.182	.246	.064	26	31.5
39	Left	17	0.2	.357	.227	.130	36	
40	Right	17	0.2	.113	.167	.054	33	34.5

more than 3 days. When a larger amount was used (in the latter groups), the purulent effusion usually broke through the capsule of the joint and infiltrated the musculature of the extremity. (Animals which, on autopsy, showed extra-articular inflammation were not included in this statistical study.)

TECHNIQUE OF NERVE SECTION

Under ether anæsthesia, preceded by a quarter grain of morphine by hypodermic, a one-half inch incision was made in the direction of the fibers of the gluteus maximus muscle. The fibers of the gluteus maximus and the underlying medius were separated by blunt dissection and retracted and the sciatic nerve exposed. The nerve to the semitendinosus leaves the sciatic about a quarter of an inch below the sciatic notch and can be easily identified and sectioned. Wounds were closed with silk and a collodion dressing was applied. The posterior approach was used because it is easy of accomplishment and does not endanger the blood supply to the muscle.

TABLE III.—NERVE SECTION

Number	Operated side	Duration	Weight of right semitendinosus	Weight of left semitendinosus	Difference	Atrophy, per cent	Daily atrophy, per cent
1	Left	2	.328	.315	.013	4	4
2	Right	3	.286	.302	.017	6	7
3	Right	3	.300	.340	.040	8.5	
4	Left	5	.405	.366	.030	9.7	12
5	Right	5	.327	.381	.054	14	
6	Right	6	.282	.358	.076	21	19.5
7	Left	6	.544	.447	.097	18	
8	Left	7	.337	.256	.081	24	24
9	Right	8	.288	.375	.087	23	23
10	Right	9	.265	.345	.080	23	
11	Left	9	.325	.256	.069	20	23
12	Left	9	.391	.294	.097	25	
13	Right	10	.343	.482	.130	29	29
14	Left	11	.617	.384	.233	37	33.5
15	Right	11	.183	.261	.078	30	
16	Right	12	.200	.303	.103	33	30.5
17	Left	12	.255	.355	.100	28	
18	Left	14	.317	.182	.135	42	42
19	Right	16	.192	.353	.161	45	
20	Left	16	.183	.126	.057	35	40
21	Left	18	.274	.163	.111	41	41
22	Right	50	.182	.345	.163	53	53

TECHNIQUE OF TENOTOMY

Under ether and morphine anæsthesia, a vertical incision was made on the inner side of the leg, just distal to the knee joint. The tendon of the semitendinosus was identified and brought into the wound with a blunt hook. It was then sectioned close to its tibial attachment. Wounds were closed with silk and a collodion dressing applied.

TECHNIQUE OF IMMOBILIZATION

For reasons mentioned above, we used the gastrocnemius for these experiments. Immobilization was accomplished by the application of a plaster spica, extending from the mid-thoracic region to the toes. The plaster bandage was applied directly to the animal, without the use of padding. The fur of the animal proved to be adequate protection against pressure sores.

This type of bandage immobilized the thigh, leg, and foot completely.

EXPERIMENTAL DATA

The results of these four groups of experiments, for the sake of brevity, are given in tabular and chart form.

CONTROLS

Nerve section. In order to ascertain whether the shock of the operation played any part in the atrophy caused by nerve section, three animals were operated upon just as for a nerve section, except that the nerve was not sectioned. After the nerve was exposed and retracted with the blunt hook it was allowed to drop back into the wound and the wound was closed. The results are shown in Table IV.

Table IV shows that operative trauma played an insignificant part in the amount of atrophy. The possibility that there is additional nerve supply to the muscle was excluded by careful dissections. In no case was an accessory or anomalous nerve supply to the semitendinosus discovered. The atrophy recorded on the chart, therefore, represents that solely due to nerve section.

TABLE IV.—CONTROL EXPERIMENTS FOR THE ATROPHY FOLLOWING NERVE SECTION

No.	Side	Days	Weight of right semi-tendi-nosus	Weight of left semi-tendi-nosus	Loss	Per cent
I	Right	5	.585	.588	.003	0
II	Left	10	.388	.377	.011	3
III	Left	16	.502	.511	....	0

Tenotomy. Lipschutz and Audova, in their experimental controls, incised the tendon itself but did not cut it through. They reported insignificant atrophy following this procedure and concluded that probably the atrophy consequent upon nerve section and tenotomy are analogous and due to the inability of the muscle to function, i.e., disuse.

In order to rule out the possibility that the trauma of operation plays some part in the atrophy in our own cases, we exposed the tendon and subjected it to friction in three rabbits. As shown in Table VI, the atrophy following this procedure was insignificant. Hence it must be concluded that the operative trauma may be disregarded and that the atrophy following tenotomy is due entirely to the section of the tendon.

TABLE V.—TENOTOMY OF SEMITENDINOSIS

Number	Side tenotomized	Duration of tenotomy in days	Weight of right semi-tendinosus	Weight of left semi-tendinosus	Difference (loss of weight)	Atrophy, per cent	Average daily atrophy, per cent
1	Right	2	.348	.331	.017	5	5
2	Left	3	.216	.199	.017	8	7
3	Right	3	.182	.194	.012	6	
4	Left	4	.540	.487	.053	9	10
5	Left	4	.331	.295	.036	11	
6	Right	5	.176	.217	.041	19	19
7	Right	6	.125	.182	.057	30	
8	Left	6	.313	.227	.086	27	27
9	Right	6	.200	.267	.067	24	
10	Left	7	.230	.167	.063	32	32.5
11	Left	7	.593	.395	.198	33	
12	Left	8	.205	.125	.080	41	41.5
13	Right	8	.195	.340	.145	42	
14	Left	9	.528	.315	.213	40	42
15	Right	9	.440	.785	.345	44	
16	Right	10	.168	.275	.107	39	41.5
17	Left	10	.295	.165	.130	44	
18	Right	12	.107	.195	.088	46	50
19	Left	12	.237	.111	.126	54	
20	Left	14	.420	.216	.204	48	47.5
21	Right	14	.201	.374	.173	47	
22	Right	16	.134	.262	.128	49	49
23	Right	18	.118	.264	.146	59	59
24	Left	20	.377	.120	.257	69	69
25	Right	35	.222	.490	.268	54	54

TABLE VI.—CONTROL EXPERIMENTS FOR THE ATROPHY FOLLOWING TENOTOMY

No.	Side	Days	Weight of right semi-tendi-nosus	Weight of left semi-tendi-nosus	Loss	Per cent
I	Left	4	.386	.378	.008	0
II	Right	12	.247	.245	.002	0
III	Left	14	.326	.314	.012	3

From the results of the immobilization experiments as shown by Table VII, we must conclude that the atrophy, if any, resulting from immobilization is slow in onset and never reaches the proportions that occur after tenotomy, nerve section, or experimental arthritis; that, in fact, it is insignificant as compared to the atrophy that occurs in these conditions.

We are unable to account for the findings of previous investigators who have reported muscle atrophy by external immobilization, unless we assume that errors in technique are responsible for the atrophy said to have been so induced. In our experiments we found it rather difficult to obtain complete immobilization of the pelvis and hip joint without at the same time producing other lesions. In

TABLE VII.—IMMOBILIZATION

Number	Side immobilized	Duration	Weight of right gastrocnemius	Weight of left gastrocnemius	Difference (loss of weight)	Atrophy, per cent	Average daily atrophy, per cent
1	Left	4	3.165	3.173	.008	0	0
2	Left	7	2.205	2.223	.018	1	1
3	Right	8	2.450	2.380	.070	0	0
4	Right	8	1.56	1.59	.03	1	1
5	Left	10	1.54	1.59	.05	0	0
6	Left	11	2.52	2.62	.10	0	0
7	Right	12	2.03	2.02	.01	0	0
8	Left	14	2.107	2.128	.021	0	0
9	Right	14	3.62	3.69	.07	2	2
10	Left	16	2.42	2.35	.07	3	3
11	Left	17	5.45	5.42	.03	0	0
12	Left	20	2.13	1.93	.20	9	9
13	Right	21	1.84	1.85	.01	1	1
14	Right	30	1.703	1.725	.02	1	1
15	Right	32	2.00	2.06	.06	3	3

fact, we found it almost impossible to obtain fixation of the hip without causing excoriations upon either the fixed or the free limb. When, on the other hand, we immobilized the gastrocnemius we obtained fixation without any complicating factors. In these experiments the atrophy not only was slow in appearing—did not, in fact, appear until the fourteenth day—but was insignificant as compared with that obtained in experimental nerve section, tenotomy, or arthritis. Inasmuch as great care was taken to obtain complete immobilization, our failure to obtain atrophy in these cases cannot be attributed to failure to obtain absolute fixation. We must conclude, therefore, that the atrophy obtained by others with experimental immobilization was caused not by the fixation, itself; it was, no doubt, due to other extraneous factors, injury, excoriation, etc., such as occurred in our experiments upon the hip joint that for this reason we discarded as inaccurate.

We think we are, therefore, justified in concluding that immobilization is not the cause of atrophy in arthritis. It does not, however, follow from this that the atrophy that follows experimental arthritis or human arthritis is not disuse atrophy. As a matter of fact, the acute muscle atrophy of arthritis may well be a *true* disuse atrophy. What we maintain is that muscle disuse in such cases is not due to voluntary or external fixation of the limb. Even if we leave out of consideration our immobilization experiments, the underlying physiological factors involved should lead us to this conclusion.

If an extremity is immobilized, e.g., in plaster, we fix the origin and insertion of the muscles with reference to each other and by this procedure muscle shortening is inhibited. The tension of the muscles, however, is still under control of the central nervous system and limitless energy may be expended in exerting muscular force to resist immobilization. Under these circumstances, there is a continued expenditure of muscle energy to produce isometric contraction in the immobilized member. Obviously, then, although voluntary shortening is inhibited when the limb is immobilized the muscles in such an extremity still continue to exercise some of their functions. Such muscles cannot, strictly speaking, be said to be in a state of disuse. As a matter of fact, complete disuse connates complete absence of all function. Hence, although it is possible that partial disuse exists when a limb is immobilized, it is not, by any means, complete, and, as has been shown by our experiments, does not lead to atrophy.

As a matter of fact a muscle can be said to have completely lost its power to function only when it has completely lost contact with the central nervous system. In this case, as has been shown by Jamin, whose work has been confirmed by many competent observers, the function of the muscle is entirely suspended and it becomes completely relaxed; in consequence it undergoes simple atrophy and the atrophy is uncomplicated by any other conditioning influences.

The nearest approach to such disuse obtains when the tendon of a muscle has been severed. In this case the neuromuscular control is preserved, and the muscle continues to receive stimuli to contract either directly or indirectly through its nerve supply; but inasmuch as muscle tone cannot be maintained unless the elastic tension is intact, the muscle remains relaxed, has therefore lost its power to function, and undergoes atrophy.

All proprioceptive stimuli are, according to accepted teaching, reflex, initiated by joint motion, and have their receptors, not in individual, but in muscle groups. If, therefore, the tendon of one muscle belonging to a group

that activates a certain joint is sectioned, more particularly when the muscle whose tendon has been sectioned is only a subordinate member of the group, this muscle will continue to receive its share of tonal stimuli so long as the joint continues to be activated by the other members of the group. Hence, such a muscle, though still receiving proprioceptive stimuli, nevertheless remains in a state of relaxation and for this reason can perform no function. Obviously, then, nerve section and tenotomy cause analogous functional disturbances in the muscle; they are both followed by relaxation; in the one the muscle ceases to function because it receives no more nerve stimuli and cannot contract; in the other the muscle continues to receive efferent stimuli and may contract, but the contraction produces no or only slight increase of tension, that is, only that caused by resistance of the weight of the muscle itself. In either case the muscle does no work and in consequence, undergoes atrophy. Under these circumstances we should expect to meet with a similar type of atrophy regardless of whether the cessation of function is caused by nerve section or tenotomy, and this is borne out by our experiments, as shown in the tables and charts which, for the most part, confirm those of Lipschutz and Audova.

EXPERIMENTAL RESULTS

Our experiments with arthritis, again, show that the atrophy that follows this condition closely resembles these two types of atrophy in practically all particulars. Only after 13 days does arthritic atrophy fail to keep pace with the above-mentioned two other types, and this is readily explained on the grounds that the irritation of an aseptic substance, such as turpentine, is limited in duration; while nerve section and tenotomy produce more permanent lesions.

In our experiments, atrophy was measurable after 48 hours following nerve section, tenotomy and acute arthritis. After this time it increased rapidly until the beginning of the second week, when a slower rate of progress ensued. On the other hand, the atrophy that followed external fixation of the limb was not appreciable until the third week and even then was not beyond the limit of error except in one case. One rabbit immobilized for 32 days (longest observed period) showed only 3 per cent atrophy, which is within our limit of error. Obviously, then, immobilization atrophy is not comparable in rapidity of onset or in degree with the other types observed.

DISCUSSION

The more plausible theories that have been suggested regarding the mechanism of arthrogenic atrophy are the following:

1. Diminution of blood supply through direct pressure of joint effusion on the muscle.
2. Poor muscle nourishment through reflex stimulation of efferent vasomotor nerves (Brown-Séquard).
3. Myositis by direct extension (Struempell).
4. Ascending neuritis from joint periphery to fibrous muscle sheath to neurolemma to nerves to nerve endings and finally to muscle (Decosse, Sabourin).
5. Absorption of the pathological effusion through lymph vessels bringing it in contact with the extensors and affecting them (Hoffa).
6. Disuse caused by fixation of the joint (Sulzer, Bum, Schiff, and Zak).
7. Reflex stimulation of trophic cord centers which directly control muscular nutrition (Paget, Vulpian, Charcot, Lefort, and Valtat).

Theories one and two, which make use of a blood diminution mechanism may, we believe, be discarded, because thrombo-angiitis obliterans and atherosclerosis may exist for years without causing notable atrophy.

Theory number one assumes the existence of joint effusion; but this is not always present clinically, and in arthritis accompanied by marked atrophy does not account for the fact that atrophy is common in muscles distant from the joint inflammation.

Concerning theory number two, it will be remembered that Vulpian, by experimental stimulation of the nerve to the musculature, failed to demonstrate significant control of the muscular blood vessels by them.

Theories three and four, those depending on direct extension of the inflammatory process, may also be discarded. Duplay and Cazin failed to demonstrate microscopic evidence of

inflammation either in the nerve or musculature in cases that exhibited arthritic atrophy. And these theories do not account for the atrophy occurring after cases of joint trauma, or atrophy at a distance from the affected joint.

Theory number five was discarded by Hoffa himself when he was unable to demonstrate that the lymphatic drainage of the knee joint anatomically approached the quadriceps muscle.

Theory number six is certainly untenable, if by disuse is meant limitation of the function of the extremity as a whole. Our failure to obtain acute atrophy in the immobilization group and the physiological conditions concerned, is adequate evidence of this. Moreover, it is known that, in cases of hemiplegia as long-standing as 15 years, and with more or less complete disuse of the hemiplegic extremity, atrophy cannot be demonstrated.

On the other hand, if it is definitely understood that more or less complete cessation of function, as caused by more or less complete relaxation of the muscle involved, constitutes disuse, these objections do not apply, and disuse in that sense is a plausible explanation of the atrophy.

That muscle relaxation, the sign of cessation of muscle function, occurs after joint trauma and infection, was first recognized by Raymond and subsequently described by Caspari who termed the condition "muscle collapse." Lorenz designated it as the first stage of arthritic atrophy and wrote that its duration may be from 2 to 48 hours. As this condition of the muscle, for reasons mentioned above, cannot be ascribed to the extension of the pathological process to these muscles, it must be assumed that it is due to an inhibition or alteration of impulses to the musculature, or fatigue due to over-stimulation.

At all events, it is certain that this muscle collapse represents the earliest neuromuscular phenomenon that presents itself in arthritis, and is a condition that resembles, in every particular, that which ensues when a nerve or a tendon is sectioned. It seems, therefore, only reasonable to suppose that the atrophy following arthritis is analogous to the atrophy of nerve section and tenotomy.

SUMMARY AND CONCLUSIONS

1. The muscle atrophy that follows the fixation of a limb is small in degree and is not appreciable before the lapse of at least a month.

2. It is not comparable to the atrophy caused by nerve section, tenotomy and arthritis either as regards its onset or the proportions that obtain in these conditions.

3. The atrophies that follow tenotomy, nerve section, and arthritis are extremely rapid in onset and the progression is almost equally as brisk in all these forms.

4. The muscle atrophies that follow tenotomy and nerve section are due to cessation of muscle function: are, therefore, true disuse atrophies.

5. The atrophy that follows experimental arthritis is preceded by muscle relaxation—"muscle collapse"—and the subsequent course is the same as that which obtains following tenotomy and nerve section. It is, therefore, reasonable to conclude that arthritic atrophy is also a disuse atrophy. The muscle disuse, however, is not caused by voluntary immobilization or external fixation, but is due to the "muscle collapse."

6. Hence, the theoretical and experimental evidence leads to the inference that, although arthrogenic atrophy must be considered a disuse atrophy, it is not due to immobilization but is caused by a reflex mechanism.

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CLINICAL SURGERY

FROM THE DEPARTMENT OF ORTHOPEDIC SURGERY, UNIVERSITY OF IOWA

THE STRIPPING OF THE OS CALCIS

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RELATIVE to the treatment of cavus deformity of the foot, the writer proposed and described in 1917 a method for the relief of the cavus deformity so far as it is caused by the contracture of the soft structures within the sole of the foot. The disappointment which had followed the usual methods for the relief of this contracture, especially of the resection of the plantar fascia, justified the advocacy of a method that promised more radical relief. It was based upon the proposition that the soft tissue contracture was caused not only by the shortened fibers of the plantar fascia but also by the structural shortening of the fibers of the short muscles of the foot, and, furthermore, of the septa which arise from the plantar fascia and which divide the soft tissues of the foot into two lateral and one middle compartments. These structures are not likely to yield to simple transection of the plantar fascia even though division is carried to the skeleton.

The method is further based upon the anatomical consideration that the short flexors of the toes originate at the rather circumscribed point at the posterior process of the os calcis. These muscles become so intensively interwoven with the plantar fascia that simple fasciotomy does not take care of all contracted elements (Figs. 1 and 3).

INDICATION

The release of the soft tissue contracture of the hollow foot by the stripping operation is a symptomatic step. In cases in which the contracture is due to the shortening of the soft structures alone, this procedure might be sufficient, but in all instances in which the skeleton takes part in the deformity, the latter must be handled separately after the soft tissues have been released, by such additional procedures as wrenching, osteotomy, wedge osteotomy, or tarsectomy, according to the case and the degree of the cavus deformity (Fig. 2). It should also be realized that the downward deflexion of the foot occurs largely in the midtarsal and in Lisfranc's joints and not in the ankle joint, so that in most instances the tendo achillis is not shortened considerably and, therefore, needs no lengthening. On the contrary, in the paralytic hollow foot, we find that the tendo achillis is usually lengthened and its condition is of prime importance in the pathogenesis of the deformity.

It should be further realized that in paralytic cases as well as in some congenital deformities in which there is an irreparable imbalance of the muscles, the restoration of form by the stripping and by the subsequent bone operation is not sufficient to assure a restoration of balance. In such cases it is quite obvious that after the form has been restored, additional measures must be considered for the maintenance of muscle balance, i.e., tendon transplantation, or more frequently, arthrodesis and other stabilizing operations upon the foot.

TECHNIQUE

A horizontal incision is made over the inner aspect of the os calcis forward to a point about 1½ inches in front of the inner tubercle of this bone. Skin and fascia are divided and then the lower or plantar surface of the plantar fascia is dissected from the layer of fat throughout its full width, from the inner to the outer border. Then the fascia is incised crosswise close to the point where it blends into the lower surface of the os calcis. The muscles covered by the fascia are, from the inner to the outer side, the abductor of the big toe and the short flexors of the toe and abductor of the fifth toe. These muscles are stripped off the periosteum of the os calcis with a blunt instrument. This is necessary since otherwise the stripping of the periosteum might give rise to the extensive formation of bone. It is also necessary to extend the stripping forward until the calcaneocuboid junction is reached on the

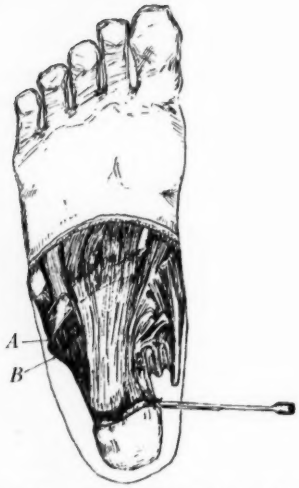

Fig. 1. Incision through the fascia and periosteum. The chisel is inserted at the inner tuberosity. *A*, Calcaneocuboid articulation; *B*, anterior border of stripped area.

outer side of the foot; one must then strip off the ligamentum plantare longum which extends between the os calcis and the cuboid, since this ligament is often contracted. A cavity of the foot at the outer border is produced by the contraction of this ligament. By keeping close to the bone in stripping, one is at a safe distance from the plantar vessels and nerves. It is unnecessary and inadvisable to make a horseshoe incision around the heel as specified in some of the later modifications of the method. Such an incision has been abandoned because of the danger of sloughing and other complications in wound healing. When the stripping of the bone has been completed, one must correct the skeletal deformity by wrenching, or if necessary, by osteotomy or wedge resection of the foot. The wound is closed by subcutaneous and skin suture and the foot is embodied in a plaster-of-Paris cast which reaches from the toe to above the knee with the latter in slight flexion to relax the tendo achillis. Such a cast must be especially well padded under the ball and over the dorsum of the foot. A good deal of correction must be applied while the cast dries. The sole of the foot should appear perfectly flat, if the effect of the stripping is to be considered complete (Figs. 4a and 4b.)

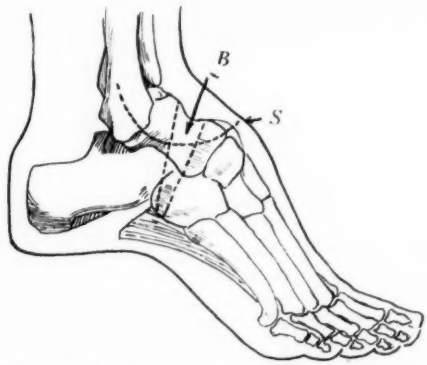

Fig. 2. Cuneiform osteotomy for the correction of the skeletal deformity. *B*, Bone wedge from neck of astragalus; *S*, skin incision over head and neck of astragalus.

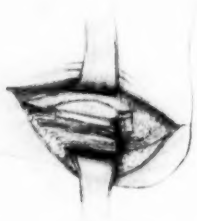

Fig. 3. Technique of the stripping of the os calcis. The plantar fascia has been dissected free from the skin and the short muscles of the foot and fascia are separated from the os calcis.

STATISTICS

As more than 10 years have elapsed since the first publication of this method and 15 years since the method was first carried out, the results of its use can be correctly evaluated. Up to the present time, 234 stripping operations have been performed in our clinic, of which 201 have been observed long and thoroughly enough to be available for statistical purposes.

The cases may be divided in two groups: one group in which the correction of the cavus deformity was the sole object and in which the stripping and wrenching of the foot alone was performed; and a second group in which the stripping and wrenching was a preliminary operation to stabilizing operations of the foot, wedge resections, osteotomies of the tarsus, or other corrective operations, such as the operation of Gleich (osteotomy of the os calcis) or the operation of Ober for club-foot deformity.

In the first group there were 143 cases, of which 122 were unilateral and 21 bilateral. In this group the average time of plaster-cast immobiliza-

tion was 4 months and the average time of observation after operation was 4 years. The results, so far as correction of the cavus deformity was concerned, were good in 112, fair in 25, and poor in 6 cases.

In the second group, 58 cases were observed, of which 51 were unilateral and 7 bilateral. Here, the average time of immobilization in plaster was 4 months, and the average time of postoperative observation was 4 years. The results were good in 50, fair in 5, and poor in 3 cases.

From the pathological viewpoint, the material is divided in four groups: 132 cases of infantile paralysis; 48 cases of congenital club foot; 12 cases of congenital progressive cavus deformity associated with spina bifida; and 9 cases of spastic hollow foot.

1. The best results were obtained in those cases of infantile paralysis in which the stripping and wrenching operation was preliminary to other, mainly stabilizing, operations. Of 38 cases in this group, 34, or almost 90 per cent, showed a good result; and 4 cases showed fair results.

Of 94 cases in this group in which the stripping and wrenching operation alone was done, 77 or a little over 80 per cent showed good results, while 15 cases, or 16 per cent, showed fair results; and 2 cases, or about 4 per cent, showed poor results.

2. In congenital club-foot deformity in which stripping was done together with the wrenching and manipulation of the foot, 97 per cent showed good results as far as the correction of the deformity was concerned and only 3 per cent showed fair results.

In 13 severer cases of congenital club-foot deformity in which the stripping and wrenching were only the preliminary step, all but 8 per cent showed good results.

3. Poorer results were obtained in the 12 cases of progressive cavus deformity of spina bifida. In

Fig. 3a. Plaster cast.

8 cases in which stripping and wrenching operation was performed as the only operation, no good results were obtained, 5 cases had fair results, and 3 had poor results; but, in the 4 cases in which stripping and wrenching were preliminary to other operations, 2 showed good results; 1, fair; and 1, poor results. The progressive type of the deformity accounts for the much poorer showing of the operation in this group. It certainly appears from the results that the stripping and wrenching operation alone could not control the situation and that secondary, stabilizing operations were necessary.

4. Of the 9 cases operated upon for club-foot and cavovarus deformity seen in spastic paralysis, 7 had stripping and wrenching alone, with 2 good,

Fig. 4a. Pes cavus before operation.

Fig. 4b. Pes cavus after correction.

4 fair, and 1 poor result. In 2 cases the stripping and wrenching operation was preliminary to other stabilizing operations with 1 good and 1 poor result.

Considering all four groups embracing 201 cases, good results were obtained in 112 with stripping and wrenching alone, and also in 50 cases in which this operation was preliminary. Poor results were obtained in 25 cases of stripping and wrenching alone, or 16 per cent of this group, while poor results were obtained in 6 cases or 4 per cent in which the stripping and wrenching constituted the principal operation.

On the other hand, of 58 cases of all groups in which the stripping and wrenching were done as a preliminary operation, in 50 or 85 per cent, good results were obtained; in 5 or 9 per cent the results were fair; and in 3 or in 6 per cent the results were poor.

SUMMARY

The operation results in definite and adequate correction of the cavus deformity so far as the soft structures of the sole of the foot are concerned. Almost always it is to be combined with wrenching of the foot, and in many instances, wedge resection and osteotomy are necessary to complete the correction of the deformed foot. Furthermore, the deformity will invariably recur unless proper measures are taken to restore the balance of the foot. Therefore, in paralytic cases, both of the infantile and spastic type, as well as in the progressive types of paralysis, stabilizing operations for restoration of balance become necessary.

The poor results obtained in this series totalling less than 5 per cent, and the fair results totalling 15 per cent, were due to errors in technique as well as errors in indication. Among the latter, failure of combination with a stabilizing operation was especially prominent. It will also be noticed that there is a high percentage of fair and poor results in the group of the progressive deformities and a fairly high percentage in spastic paralysis. In the congenital club-foot group, failure was due not so much to error and technique, as in the correction of the club foot itself, and was not directly attributable to the stripping operation. It was in this group, also, in which the largest percentage of recurrences was found. In the cases of infantile paralysis the failure of the operation was due to error in indications rather than to error in technique, and, since arthrodesing operations are performed more frequently and the indication of these are being made more liberally, fewer instances of recurrence of the cavus deformity are being observed.

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FROM THE ST. LOUIS CHILDREN'S HOSPITAL

THE FREDET–RAMMSTEDT OPERATION FOR CONGENITAL PYLORIC STENOSIS

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A NEW operation for the relief of congenital pyloric stenosis was suggested by Fredet in 1910 and the results of the operation were published by Fredet and Rammstedt almost simultaneously in 1912. Up to this time the generally accepted method of treating infants with pyloric stenosis was to do a gastro-enterostomy. This gave excellent results in cases that recovered, but as it required a high degree of technical skill and experience in infant surgery the mortality rate was about 25 per cent even in the hands of the best surgeons. This made the procedure too formidable for use except in the cases in which every detail clearly pointed to a satisfactory outcome and many cases in which operations were not performed because of the fear of postoperative mortality resulted in death.

Since about 1915 the simple operation which we are to describe has been universally adopted because it is easily performed and efficient and has a negligible mortality.

The diagnosis rests on the following signs and symptoms: the spitting up of food beginning shortly after birth and becoming progressively worse until after 3 or 4 weeks the vomiting becomes projectile, the stools becoming less frequent and smaller, and in the fully developed case the gastric peristalsis with its ball-like waves is evident to even the tyro. In the advanced case the pyloric tumor can be felt when the stomach is empty. The palpation of a tumor was at one time the criterion that settled the question of operation, but now we do not think it necessary to wait for the hypertrophy of the pylorus to become so large that it can be distinctly felt before advising operation, because while the pylorus is enlarging the stomach is dilating and its wall is thickening because of the increasing work necessary to empty the viscus against progressive stenosis of the pylorus. The late cases with large and thickened stomachs are handicapped in their recovery because of the time required for the overworked stomach to return to normal.

Most of these cases are brought to the hospital markedly dehydrated and at times showing alkalosis. To overcome these conditions abundant subcutaneous injections of Ringer's solution are necessary. If athrepsia is present, glucose solution intravenously or whole blood transfusion is indicated. We regard the preparation of the patient for operation as one of the most important factors in the handling of these cases. Frequently 18 to 24 hours is given to the replacing of fluid loss and the counteracting of starvation symptoms before we dare operate. Hence, the big part of the battle is fought before we enter the operating room.

In general the factors which tend to increase the operative risk are: (1) a disturbance of the acid-base equilibrium of the body, (2) anhydræmia, (3) marked asthenia due principally to malnutrition and anæmia, and (4) the presence of infection.

Marked vomiting, when due to pyloric stenosis, causes loss in the vomitus of hydrochloric acid, usually in large amount, and of base chloride in smaller amount. The loss from the body of the chloride ion is almost invariably compensated for in a large part by retention of the bicarbonate ion in the blood and tissue fluids, leading to alkalosis of varying severity. Such a shift toward the alkaline side is just as serious as a commensurate shift to the acid side (acidosis), if not more so. Death may occur promptly, as a result of collapse, cessation of respiration, or generalized convulsions with laryngeal spasm. Aside from loss of acid by vomiting, alkalosis may be increased by any measure which would tend to cause exaggerated breathing. Such instances are commonly seen as a result of crying because of hunger, pain, or manipulation. It is important then since all of these factors may be present before, during, or immediately after operation, to restore if possible the acid-base balance of the body to its normal equilibrium, before operation.

The diagnosis of alkalosis can be made both clinically and chemically. In the first place, alkalosis of some degree almost invariably accompanies marked vomiting due to some type of obstruction of the gastro-intestinal tract. It is, therefore, always expected in cases of pyloric stenosis; especially if breathing is shallow, depressed, and irregular with frequent long apnœic pauses. Further evidence of alkalosis might be noted in the appearance of general hypertonicity and such evidences of tetany as carpopedal spasm, positive Chvostek sign, or generalized convulsions. The urine characteristically is free from chloride (when acidified gives little or no white precipitate after the addition of silver nitrate) but also contains so little base-bicarbonate ($BHCO_3$) that it is distinctly acid (pH 5–6) in reaction. This latter point is of importance. Ordinarily, alkaline urine will rule out the presence of acidosis of any type except that associated with nephritis, but acid urine not only does not rule out alkalosis, when of the type associated with vomiting, but its presence actually lends support to this diagnosis. Certain diagnosis of alkalosis,

Fig. 1. Showing the size of the area injected with a solution of .25 per cent novocain in normal salt solution.

however, can be made by chemical examination of the blood. Increased pH (alkalinity) and CO_2 content (base bicarbonate) will be found associated with diminished base chloride.

Not only does this disturbance of the acid base balance tend to produce tetany and its consequences, but it also contributes to anhydræmia. In addition to the fluid loss of food intake, there occurs the loss of water bound to HCl and BCl. These two factors, i.e., disturbance of the acid base balance and anhydræmia are, therefore, closely associated and the treatment for both is carried out at the same time. The treatment in general consists of the administration of water and salt in the form of Ringer's solution. As a rule Ringer's solution is administered subcutaneously two to three times daily until the chloride content of the blood remains at approximately the normal level. When this occurs the bicarbonate content of the blood will have dropped to approximately the normal level because of the excretion of bicarbonate into the urine, which now renders the urine highly alkaline. At the same time anhydræmia disappears. In a few severe cases, showing very marked chloride reduction, it may be necessary to give a more concentrated salt solution, such as a 3 per cent sodium chloride, subcutaneously, but this rarely has to be done.

If at any time acute manifestations of alkalosis are seen, such as tetany or marked depression of the respirations, immediate measures directed toward relief of these acute symptoms will have to be instituted. They are: (1) the breathing of 30 per cent CO_2 in oxygen. This is a quick and effective means of stimulating respiration, of providing sufficient oxygen to saturate the hæmoglobin, and to increase the free carbonic acid of the blood so that the ratio $NaHCO_3$: H_2CO_3 becomes more nearly normal due to the increase in the denominator. When this happens the acute signs of tetany are relieved. In addition a 5 per cent calcium chloride solution in an amount equivalent to ½ cubic centimeter per kilogram body weight is given intravenously. Calcium given in this way is also immediately effective in relieving tetany. A drug which acts in a similar manner and which is sometimes used is a 10 per cent anhydrous magnesium sulphate, given in 2 doses each of 1 cubic centimeter per kilogram of body weight, 15 or 20 minutes apart. Magnesium is just as effective as calcium in relieving tetany, but has one distinct disadvantage in that it tends to depress the respirations which, because of the presence of alkalosis, are frequently already depressed. If, however, depression of respirations follows the administration of magnesium sulphate, calcium chloride may then be given as an antidote to magnesium sulphate for this depressant effect.

Occasionally an infant is so weak because of starvation and anæmia that he would be a very poor operative risk. In such instances frequent intravenous injections of from 10 to 20 per cent glucose are given very slowly so as to provoke as little diuresis as possible. Fluid and some immediate food in this way are given. Blood transfusions are also resorted to and in addition an attempt is made to give the infant the usual thick cereal feedings preceded by atropine in physiological dosage.

Very frequently otitis media is seen associated with pyloric stenosis. Presumably the high incidence of otitis media in these cases results from the vomiting and the forcible introduction of vomitus into the eustachian tubes. The operative risk in such cases will be lessened if the otitis media is recognized and treated as it would be in other cases.

After operation all the measures described as being of importance before operation may have to be continued, if the factors already enumerated still exist. In addition it is important to institute the proper regulation of feeding; i.e., atropine and thickened feeding are discontinued, and breast milk or the usual artificial formula (whole lactic milk with 3 ounces of Karo corn sirup to the quart) are used instead. Two hours after the operation ½ ounce of water is given by mouth and 2 hours later ½ ounce of pumped breast milk or formula. Water and milk are then given alternately every 4 hours, increasing by ½ ounce every other feeding. In this way, by the end of the second day the infant will, as a rule, be able to take his full formula or, if breast fed, may then be put to the breast.

The operation is done on an improvised hot water table and the baby's arms, chest, and legs are wrapped in cotton wool or flannels to protect against chilling. The skin of the abdomen is prepared with alcohol.

Our choice of anæsthetics is .25 per cent novocain in normal salt solution. We use about 60 cubic centimeters over the upper right rectus muscle and in the muscle sheath. The injection is so done as to raise a large tense lump under the skin (Fig. 1). An interval of from 10 to 15 minutes after injection permits considerable absorption of the fluid injected. The incision is then made through the œdematous tissues, the peritoneum being anæsthetized by the forceful injection of fluid beneath the rectus sheath. No general anæsthetic is used except that in about 1 out of 10 cases a few whiffs of ether are needed when the wound is being closed.

The incision, about 2 inches long over the outer border of the rectus, exposes the lower edge of the liver, which is held aside to expose the

Fig. 2. Blunt dissector used in dividing the hypertrophied pyloric ring.

Fig. 3. Division of the hypertrophied pylorus with the blunt dissector.

Fig. 4. Showing closure of the peritoneum.

greater curvature of the stomach. This edge of the stomach is drawn into the wound with rubber covered forceps and is followed until the pylorus presents. When the olive shaped, hard, hypertrophied mass is brought into the wound, the index finger of the left hand is hooked over its upper surface and the pylorus drawn well out and held in place by the crooked finger. On the upper anterior face of pylorus, there is a practically avascular area which we select for the incision. The incision is made solely with a blunt dissector which was originally designed as a fine dural elevator, although any delicately blunt instrument will do (Fig. 2). The peritoneum and the hypertrophied muscle are as easily divided with this blunt instrument as normal tissue is with a knife (Fig. 3). The blunt instrument is advantageous because it makes injury to the submucosa, which is exposed over the whole area beneath the muscle incision, practically impossible. The divided ends of the muscle are spread apart, the submucosa that has been confined by the constricting bundle pouts out, and the relief of the stenosis is plainly shown. Another advantage of the blunt dissection is that it is almost impossible in this way to divide the muscle of the normal duodenum and stomach. If by any chance this unhypertrophied muscle is cut, bleeding results and a ligature may be required. However, if no damage is done to normal muscle, there is almost never any bleeding.

The pylorus is now dropped into the peritoneal cavity and the peritoneum of the abdominal wall is closed with fine catgut. A small spoon is used as a spatula beneath the line of suture (Fig. 4). As the last stitch is about to be tied, we insert a tapered glass tube and through this introduce as much warm salt solution as the peritoneal cavity will hold. When about 100 to 150 cubic centimeters have been introduced, the solution begins to flow back around the sutures. The tube is then removed and the last stitch tied. The wound is sutured with catgut for muscle and fascia, but we bury 3 to 5 fine silk sutures that include the muscle and fascia. We use these non-absorbable sutures because under any circumstances healing is poor in undernourished infants and we have seen wounds that were sutured with catgut alone break down throughout. The skin is closed with a silk stitch that includes only the epidermal tissues which in about 9 or 10 days is entirely loose and we are spared the task of taking interrupted skin stitches out of a squirming youngster. To complete the operation a small pad of dry gauze is placed over the wound and held in place by

means of small adhesive plaster strips and a narrow binder.

During the operation the baby has a holeless nipple in its mouth as a pacifier and in over half of the cases does not cry at all. In most instances the operation takes only a few minutes and the child leaves the table looking as well if not better than before operation.

The infant is returned to the ward in its cotton wrappings, and in 2 hours is given a few sips of water. Two hours later it receives small feedings which are gradually increased as already indicated. In a few days the full sized feedings are given, and the infant begins to gain weight. In those cases with but little stomach irritability, vomiting ceases after operation, provided one does not increase the size of the feedings too rapidly.

In long standing cases in which the stomach has been considerably dilated there may be a little spitting up for a few days until the stomach regains its proper tone. The baby is kept in the hospital only as long as it is necessary to get the picture of improvement. The infants in better condition go home before the end of a week, but the poorly nourished ones may have to remain two weeks.

We have operated upon 81 cases; in the first 29 cases there were 8 deaths, in the last 52 cases there have been 2 deaths, 1 of the latter deaths being due to a pneumococcus peritonitis, the other being due to a peritonitis which started from a small puncture wound of the intestine made by a needle when the wound was being closed. The deaths in the first 29 cases would probably have been much fewer had we understood the necessity of proper preliminary preparation, but most of these fatal cases had been treated as emergencies and the necessary adjuvants deferred until after operation. Of the 8 deaths 2 were due to gastro-enteritis, 1 to pneumonia, and 1 to otitis media; the others were not definitely explained except as due to inanition.

Bowling and Downes report results in 454 cases with a total mortality of 15 per cent, but in the last 130 cases a mortality of only 8.5 per cent. Mixter in 195 cases had a mortality of 9.5 per cent. Strauss reports a mortality of 3.2 per cent, which he ascribes to careful preparation with transfusion and glucose.

IMPROVEMENTS IN PERINEAL PROSTATECTOMY PERMITTING PRIMARY WOUND CLOSURE AND HEALING WITHOUT DRAINAGE

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As late as 1887, Sir Henry Thompson stated that successful prostatectomy was unknown. At that time in his *Treatise on the Diseases of the Prostate*, which is still a classic of great value, he said: "I desire extremely to see such a result; I have on four occasions removed considerable portions of the prostate, but without success. I have traveled considerable distances abroad expressly to see it, but without success."

The first man to make a success of prostatectomy was Goodfellow, of San Francisco, (4) in 1891. His operations were performed by the perineal route. Although sporadic instances of earlier perineal prostatectomies exist, they were as a rule partial and merely incidental to the operation of perineal lithotomy, or cutting for stone. Goodfellow's technique consisted in placing the patient in the ordinary lithotomy position, cutting down through a median incision (Fig. 1B), onto a lithotomy staff in the urethra, slipping a finger through the prostatic urethra into the bladder, and enucleating the gland. Although a blind operation, it required but 5 to 10 minutes for its execution. In 1904, he reported 73 cases with 2 deaths. He apparently was not troubled with postoperative hæmorrhage and used no measures to check bleeding at the time of operation.

About 1900, Proust (8) and Albarran evolved a perineal technique paralleling in some respects the Young technique but differing in essential features, and today the Proust operation has been entirely abandoned. The operation of perineal prostatectomy which is most widely practiced today had its inception with Young in 1903 (10). What favor the operation now enjoys in the United States is due entirely to the work of Young, who has brought it to a high state of perfection. Its main advantages over the old Goodfellow procedure are that the operative field is at all times under direct vision and the possibility of injuring important structures such as the internal and external vesical sphincters is obviated.

The credit for the first complete suprapubic prostatectomy belongs to Eugene Fuller (6 and 12), of New York, and was done in 1894. His work was preceded by that of von Dittel in 1885 (9), Belfield in 1886 (1), and McGill (7), in 1887, but these earlier operations were for the most part incomplete removals of the hypertrophic portions of the prostate. Freyer (3), of London, who began his work in 1901, probably did more than anyone else to popularize suprapubic prostatectomy, and claimed priority for doing a *complete prostatectomy*.

Today we are interested in doing not a complete prostatectomy but a complete adenectomy, shelling out completely the hypertrophic portions of the gland from its false capsule of compressed glandular tissue. The term *complete prostatectomy* is now used only in reference to the radical operation of Young (11) for carcinoma of the prostate.

Twenty years ago the mortality in prostatectomy was 20 per cent, or more. Today, in the hands of the trained urologist, it is 5 per cent, or less. This is a remarkable fact when one considers the unusually poor risks that are encountered in the senile sufferers with prostatic hypertrophy. In the hands of the general surgeon and general practitioner, the mortality of prostatectomy is still in the neighborhood of 20 per cent. This is due to the fact that many of them are not familiar with, and do not recognize the importance of, proper pre-operative and post-operative treatment in these cases, and furthermore, they do not learn to differentiate accurately the various types of prostatism, which can be done only with the aid of the cystoscope. It is essential that the type of prostatism be accurately determined so that the proper treatment may be instituted for the particular type of obstruction encountered. For example, in contracture of the vesical neck, or median-bar formation, the treatment is entirely different from that for prostatic hypertrophy, yet the symptoms are identical. Hunt, of the Mayo Clinic, has shown rather conclusively that no matter how excellent a given risk may be, the patient should have at least 10 days' preparatory treatment in the hospital prior to operation. Poor risks may require much longer. It has been truly said: "The removal of the obstructing prostate is but a mere incident in the treatment of prostatic hypertrophy." Until the general surgeon recognizes these facts, patients with bladder-neck obstructions will continue to be much safer in the hands of the urologist.

Fig. 1. Illustrating the types of incisions used in perineal prostatectomy. The transverse semilunar incision (A) is most suitable for the operation herein described. Note the Crowell tractor which has been passed through the urethra into the bladder.

Fig. 2. The second step in the operation, following the primary incision through the skin, is illustrated, namely, the penetration of ischiorectal fossa on either side of the central tendon posterior to the transversus perinei superficialis muscles. The point of penetration is on a line joining the ischial tuberosities. The index finger enters easily by blunt dissection until the apex and posterior surface of the prostate are felt.

Both the suprapubic and perineal operations of prostatectomy have become fairly well standardized, yet they share one fault in common, and that is our present crude methods of dealing with bleeding at the time of operation. Gauze packing is commonly used to obviate the danger of hæmorrhage, and also distensible rubber bags, but they both offer the same objections: (1) they stretch open still further the dilated prostatic cavity, which under ideal conditions should be permitted to collapse and shrink as soon as the gland is removed; (2) they cause the patient discomfort not only by their presence but by their removal as well; and (3) they delay wound healing by leaving behind them a temporary urinary fistula on their withdrawal, which requires ordinarily from 2 to 4 weeks to close, and in some instances even longer. Packing is not an ideal way of controlling hæmorrhage in any operation, and least of all in prostatectomy where urinary drainage acts as a deterrent to wound healing. In general surgical operations, packing is always a last resort when other methods fail to control hæmorrhage, and so it should be in prostatectomy also. Consequently, it is desired to present here certain slight modifications in the technique of perineal prostatectomy which render it not only simpler and more foolproof, but which also *permit primary closure and healing of wounds by avoiding the use of packs or bags*, and thereby materially shorten convalescence and hospitalization.

Prior to operation, blood grouping and coagulation time are determined routinely. Certain prophylactic measures designed to minimize the likelihood of postoperative hæmorrhage have been recommended, but are perhaps of debatable value. It has been suggested that for 3 days prior to operation the patient be given a cup of jello twice daily, and 20 grains of calcium lactate, 3 times daily by mouth. Parathormone (Lilly) 15 units may be given subcutaneously twice on the

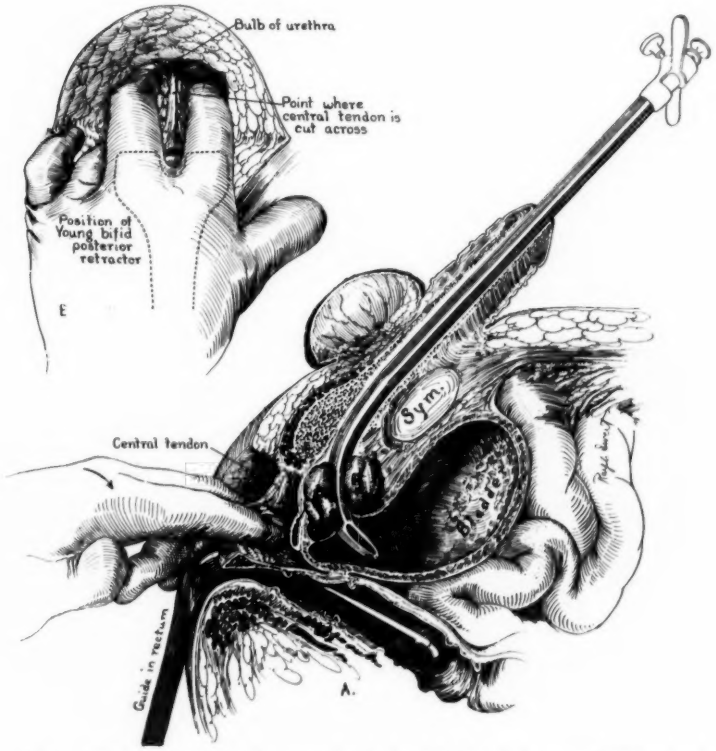

Fig. 3. The third step in the operation is the division of the central tendon back of the bulb and transversus muscles, B. During this procedure the rectum is retracted posteriorly with either the Young bifid retractor or two fingers of the left hand. A is a lateral view of the perineal structures and their relations. The central tendon has been placed under tension preparatory to its division. Note the Crowell tractor passing through the urethra into the bladder with its blades opened and forcing the prostate down toward the wound, the symphysis pubis acting as a fulcrum. Note, also, the instrument in the rectum serving as a constant guide to its location.

day before operation. The recent work (5) of Gordon and Cantarow points to parathyroid extract as having a possible value in hæmorrhage control. If it is deemed advisable, fibrogen may also be given subcutaneously and calcium intravenously. These measures may be repeated again an hour or two before operation. Anaphylaxis from the use of these things must be guarded against, and is not without danger.

Following operation, no matter what means are used to control hæmorrhage, one occasionally meets with a case that will give rise to apprehension. Then it is essential with an adequate syringe to keep the bladder and retention catheter free from clots, to repeat the measures above outlined, and in addition to try injections of ephedrine or pituitrin subcutaneously. Sodium citrate given intravenously is said to shorten coagulation time. Plenty of fluids by hypodermoclysis and rest obtained by morphine are essential, if there is postoperative bleeding. The bladder may be flushed with a warm solution of potassium permanganate 1:4000, and if necessary an instillation of 10 per cent antipyrin solution may be given. Irrigating the bladder with a 2 per cent alum solution followed immediately by an instillation of 1 ounce of 50 per cent aluminum acetate mixture, which is retained, often serves a useful purpose. The perineum is tightly compressed with a double spica bandage, a roll or two of rolled bandage being placed against the perineum to exert additional pressure. Intramuscular injections of

Fig. 4. Photograph of the rectal guide. This may be inserted at the beginning of the operation or at any subsequent stage should there be doubt as to the exact position of the rectum. Such a device gives positive insurance against rectal injury, which is the main bugbear of the perineal operation.

whole blood seem occasionally to be useful. It may in rare instances be necessary to re-open and pack the wound, and as a last resort to give a blood transfusion.

On the morning of operation, before the patient leaves his room, the urethra and bladder are thoroughly irrigated with a 4 per cent solution of boric acid, followed by the instillation of 1 ounce of 5 per cent argyrol. Gas and oxygen anæsthesia is given those patients "who do not wish to be present at their own operation," otherwise, spinal anæsthesia is used in most cases. For spinal anæsthesia 3 cubic centimeters of a 5 per cent solution of allocaine (Lumiere) with the addition of adrenalin is ideal.

The next step of importance in perineal prostatectomy is the position of the patient. The ordinary lithotomy position with feet in stirrups, exactly as used by the gynecologist for vaginal repair, is entirely adequate for an excellent exposure of the prostate. The operator can sit and work at ease. The buttocks must project slightly beyond the end of the table so as not to interfere with the retractors. The perineal board and other special apparatus designed to improve the exposure of the prostate, I regard as totally unnecessary encumbrances which only add to the complexity of the operation, and the discomfort of the patient. The perineal board was originally devised by Halstead for rectal work and adopted by Young for perineal prostatectomy. It served a useful purpose in the developmental phases of their work, but now in the light of more definite anatomical knowledge and established surgical procedure it is not essential. The hips can be flexed just as completely with the patient lying in a comfortable horizontal position as by standing him virtually on his head on the perineal board. I can see no advantage in any type of perineal elevator. Even sandbags are unnecessary.

The technique followed in the operation is essentially that of Young, with minor changes which will be described. The accompanying reproductions of drawings of an actual operation render superfluous detailed description. Figures 1, 2, and 3 illustrate the primary incision with the Crowell tractor in place, the penetration of the ischiorectal fossa on either side of the central tendon, and the division of the latter structure.

We now approach the crucial part of the operation, which is the Waterloo of the novice. It must be constantly borne in mind that the rectum is always in close proximity throughout the exposure of the prostate, and that it is held anteriorly against the posterior surface of the gland by the recto-urethralis muscle. This muscle is not a distinct entity but represents merely the attachment of a portion of the longitudinal

Fig. 5. The crucial step in the operation is the manner of dealing with the recto-urethralis muscle following division of the central tendon. This muscle is not a definitely demarcated structure but merely represents certain fibers of the longitudinal muscle layer of the rectum which insert in the region of the apex of the prostate and hold the rectum in close apposition to its posterior aspect. In the illustration a dotted line shows where the recto-urethralis is split near its insertion while two fingers of the left hand hold the rectum down out of the way. The recto-urethralis is placed on tension by retracting the urethral bulb anteriorly.

muscle fibers of the rectum to the region of the apex of the prostate, so that at this point there is no definite line of demarcation between rectum and prostate. To facilitate the exposure of the prostate at this stage without danger of injuring the rectum, a rectal guide (Fig. 4) has been devised. For an expert perineal surgeon it may often be superfluous, yet it may prove very comforting at times. With the urethral tractor on one side and the rectal guide on the other (Fig. 3A), the surgeon is guided unerringly to his destination, just as a ferry boat is guided into its slip by the bulkheads on either side. Thus having one's bearings, it is easy to make a small midline slit through the recto-urethralis near its attachment to the apex of the prostate (Fig. 5), grasp each side of the opening with Allis forceps, and slip a knife handle down over the posterior surface of the prostate between the layers of Denonvilliers' fascia (Fig. 6). This opening is enlarged enough

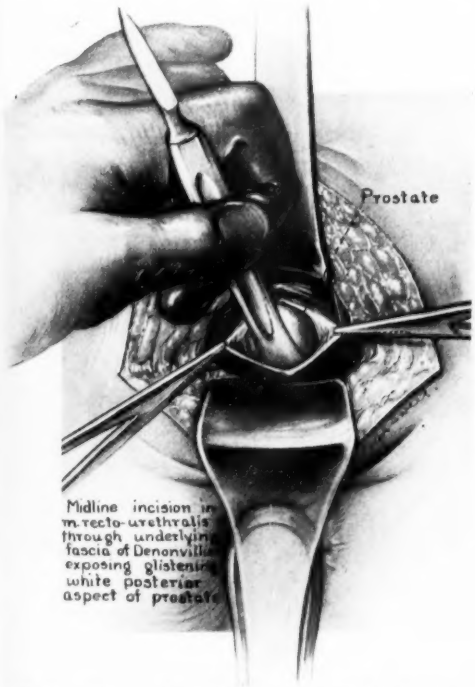

Fig. 6. The margins of the midline slit in the recto-urethralis are grasped with an Allis forceps and a knife handle slipped down over the posterior surface of the prostate between the layers of Denonvilliers' fascia which covers the posterior aspect of the prostate gland. The smooth, glistening, greyish-white surface of the prostate is now visible.

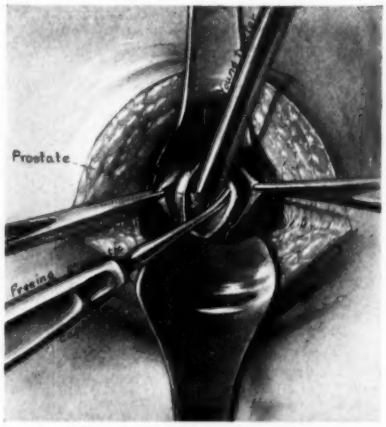

Fig. 7. A midline incision is made in the prostate onto the instrument in the urethra. This incision is extended toward the base of the prostate and does not approach too closely the apex where the external vesical sphincter lies. The plane of cleavage between capsule and prostate is now revealed and enucleation is begun with the Kocher dissector. If it is considered expedient, the Crowell tractor is removed and replaced by the short Young prostatic tractor, which is passed through the wound into the bladder and its blades opened so as to aid in the enucleation by bringing the prostate into the wound.

to permit a midline incision through the prostate on to the instrument in the urethra (Fig. 7). This incision is between the ejaculatory ducts and apparently does no harm either to the ejaculatory ducts or to the verumontanum. Following prostatectomy, cystoscopic inspection of the posterior urethra in two cases has shown a normal looking verumontanum, and sexual potency has been preserved in a fair percentage of cases. As a matter of fact, injury to the verumontanum is probably of little consequence, and I recall one instance in which the verumontanum was accidentally removed with the prostate without loss of the sexual powers.

As has been shown, the operation following the cutting of the central tendon has been confined strictly to the midline, and thus the nerves and blood vessels which course laterally are avoided. The enucleation of the prostate is accomplished as shown in Figures 7 and 8A. Since the whole field is under direct vision, there is practically no danger of leaving hypertrophic remnants which might lead to recurrence.

With the prostate removed, we now have the condition shown in Figure 8B. A smooth, round, snug internal sphincter is usually left following the enucleation. It is beneath the edges of the mucosal flap that the chief bleeding is apt to

Fig. 8. Completion of the enucleation of the prostate, A. The prostate is shelled out either *en masse* or piecemeal with the index finger sometimes aided by curved scissors, care being taken not to tear the incision in the prostatic capsule. Following enucleation the prostatic fossa can be visualized, B, and measures instituted to control bleeding as outlined in the text.

occur. In the past it has been the custom of the surgeon, in his inordinate hurry to complete the operation, to insert gauze packing immediately after the enucleation, and to close the wound without any special effort to ascertain the nature of the bleeding. Probably most prostatectomy patients would cease bleeding if nothing were done, but it is not safe to leave nature to its own devices. Why not take 5 minutes at this stage of the operation to stop any bleeding, and if possible to avoid the use of packs or bags? The bleeding surface is under direct vision in the perineal operation, and can be thoroughly inspected with the aid of a Speclight, a Cameron light, or some other means of illumination. Spurters and bleeding points can be readily caught with a hæmostat and ligated. Occasionally a suture in the flap of vesical mucosa will check hæmorrhage. A mattress suture of the posterior lip of vesical mucosa to the prostatic capsule is sometimes used with good effect, because it is there that the most troublesome bleeding usually occurs. The Young boomerang needle is useful for this maneuver. For general oozing, stick sponges saturated with hot sterile Monsell's solution of 10 per cent strength applied to the oozing surface are extremely satisfactory. This solution has been used at the suggestion of Dr. Henry Meyer, of San Francisco, who has used it for 15 years in suprapubic prostatectomy with good results and without causing any apparent injury to the tissues or delay of wound healing.[1]

[1] A mixture of four drachms of tannic acid to one ounce of adrenalin is likewise of value for hæmostasis.

Once careful inspection shows that all bleeding has ceased, it is then safe to dispense with packing or bags. The wound is closed as illustrated in Figures 9, 10 and 11.

After returning to bed, the patient is routinely given 1000 to 2000 cubic centimeters by hypodermoclysis, and the urethral catheter is connected with a Connell suction apparatus, in order to keep the bladder drained dry and to keep urine off the healing wound. The Davis bottle, Chapman filter pump, or any other type of suction apparatus which does this satisfactorily may be used.

Abstracts of 4 representative cases are appended. Cases 1 and 2 show what may occasionally be accomplished by the old method of routine packing and drainage. In Cases 3 and 4, the wounds were closed without packing or drainage, according to the technique which has been described.

CASE 1. C. P., 69 years of age, had a moderate-sized glandular type of hypertrophy removed by the perineal route. Spinal anæsthesia (allocain) was used. At the close of the operation, a 28 F. catheter was passed to the bladder through the urethra, and a 28 F. through the wound to the bladder. The prostatic fossa was packed with 2-inch gauze strips and the wound closed as shown in Figures 10 and 11. After the patient was taken to his room, a Connell suction was started. The gauze pack and perineal catheter were removed in 48 hours. The patient sat up on the fifth day and began walking on the seventh day. The urethral catheter was removed on the ninth day. There was no drainage through the perineum at any time following operation in spite of the fact that the wound had been disturbed by the presence of the packing and the perineal tube. The patient was discharged from the hospital on the fifteenth day after operation in excellent general condition. The wound had healed solidly without any reaction, and there was good functional control of urination.

CASE 2. R. M., 72 years old, had a small adherent mixed fibrous and glandular type of hypertrophic prostate removed under spinal anæsthesia (neocain). Urethral and perineal catheters, together with gauze packing, were used as in Case 1. Connell suction was used continuously to keep the bladder dry following operation. The perineal catheter and packing were removed in 24 hours. The urethral catheter was removed on the seventh day after operation and the patient began to get up. At no time was there any leakage of urine through the perineum. However, a mild attack of epididymitis without fever occurred so that the patient was not allowed to leave the hospital until the twenty-second day after operation.

CASE 3. C. B., 63 years old, had perineal prostatectomy performed under spinal anæsthesia (tropocain). The large, soft, glandular type of hypertrophied prostate shelled out easily with almost no bleeding. The incision was closed without packing or drainage of any sort, as shown in Figure 10b. A 28 F. catheter was placed in the urethra and the bladder kept dry with continuous Connell suction. The catheter was removed on the tenth day. The wound healed *per primam* without the slightest sign of reaction or drainage, and the patient left the hospital on the fourteenth day after operation in excellent general condition and with good control of urination.

Fig. 9. Drainage is provided via the natural channel by means of a 28 F. catheter passed through the urethra into the bladder. A second catheter through the wound to the bladder is used only in those cases in which it is necessary to resort to packing to control hæmorrhage.

CASE 4. O. I., 66 years old, had large glandular type of prostate removed perineally under spinal anæsthesia (allocain). The wound was closed without packing or drainage, as shown in Fig. 10b. A retention catheter was placed through the urethra to the bladder at operation and Connell suction was constantly maintained until the seventh day after operation and the patient got up out of bed. The wound healed *per primam* without the slightest redness or reaction of any kind, and the patient was discharged from the hospital on the twelfth day after operation in good condition, and with good control of urination.

If packing is used, it is only in rare cases that primary healing without urinary drainage occurs as in Cases 1 and 2. In general, 2 to 4 weeks are required for a urinary fistula to heal. All of the cases in which bleeding has been controlled without resorting to packing and in which the wound has been tightly closed without the institution

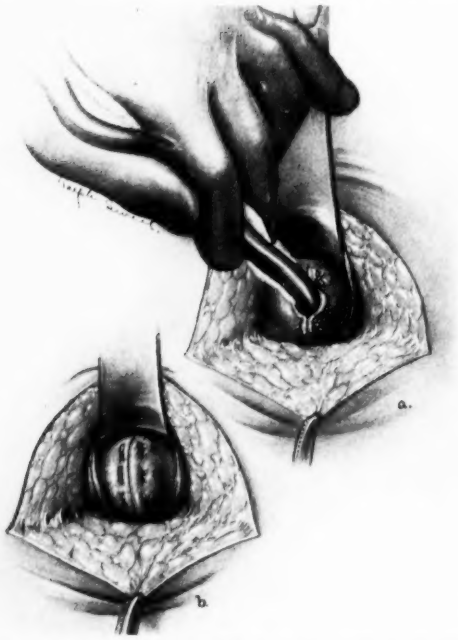

Fig. 10. Showing the method of closure of the perineal wound following prostatectomy. If packing can be avoided, the perineal catheter is likewise omitted and the incision in the prostatic capsule closed tightly with mattress sutures of No. 2 chromicized gut. In upper drawing is shown the manner of suturing the prostatic capsular incision when packing is deemed necessary.

Fig. 11. Completion of wound closure, consisting in approximation of perineal musculature with mattress sutures of No. 2 chromicized gut. When bleeding has been controlled without the use of gauze packing the perineal catheter is also dispensed with, and the perineal wound closed tight without drainage of any sort. All drainage is then via the retention catheter in the urethra, which is removed usually within 6 to 9 days after operation. Perineal packing and catheter, when used, are removed in 48 hours.

of drainage, as in Cases 3 and 4, have healed *per primam* without subsequent breaking down. All of the cases reported have had infected urine. Follow-up records in these 4 cases have shown an excellent ultimate result. Closure of urinary wounds without drainage is contrary to one of the oldest axioms of surgery, yet in these cases we have an outlet for drainage through the natural channel, and experience has now shown that this can be safely done in many cases without jeopardy to the patient, at the same time shortening his stay in the hospital, saving dressings, and adding to his comfort while there. Perineal prostatectomy ordinarily requires 30 to 45 minutes' actual operating time. Why not spend an extra 5 minutes in the systematic control of bleeding, if it will save the patient 2 weeks or more in the hospital?

SUMMARY

1. Prostatectomy is still a relatively recent development in the field of surgery, having first been successfully performed by Goodfellow, who began to do perineal prostatectomies in 1891. Suprapubic prostatectomy has an even more recent origin as the first successful operation of this type was performed by Fuller in 1894, and popularized by Freyer in 1901.

2. The great reduction in mortality rate which characterizes prostatectomy in the hands of the trained urologist today has been achieved as a result of more accurate differential diagnosis, and fuller realization by the surgeon of the importance of thorough pre-operative and post-operative treatment, bearing in mind that the operation itself is "but a mere incident in the treatment of prostatic hypertrophy."

3. In spite of its present high plane of achievement, prostatectomy, both suprapubic and perineal, is subject to certain defects, chief among which are our present crude methods of controlling bleeding by the use of packs and bags of various sorts. Such subterfuges are regarded only as a court of last resort in other surgical operations, and this should be particularly true in

prostatectomy in which they delay wound healing and encourage the prolongation of urinary drainage.

4. Modifications in the technique of perineal prostatectomy, together with methods of dealing with bleeding are outlined which should, in a high percentage of cases, permit primary wound closure and healing without urinary drainage and thus add materially to the brevity and comfort of the patient's stay in the hospital. The technique employed is essentially that of Young except that the patient is placed in the ordinary lithotomy position; a special instrument is inserted into the rectum to guard against injury to that structure; a midline incision is made in the prostate which permits easy closure following enucleation; under careful visualization bleeding is entirely checked by suture and sponging with warm 10 per cent Monsell's solution; and the wound is closed tightly in layers with mattress sutures of No. 2 chromicized gut, without drainage. All drainage is taken care of by an adequate suction apparatus attached to a retention catheter in the urethra.

5. Four illustrative cases of perineal prostatectomy are reported in which healing occurred *per primam* without urinary drainage through the wound at any time. Three of them were discharged from the hospital 2 weeks after operation, in excellent condition. The fourth patient was not allowed to leave the hospital until 3 weeks after operation owing to the occurrence of a mild attack of epididymitis.

It is hoped that this contribution will mark a new epoch in prostatectomy which will bring it a step closer to the goal of an ideal operation.

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PREGNANCY TERMINATED BY CÆSAREAN SECTION AFTER URETERAL TRANSPLANTATION INTO THE SIGMOID

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THROUGH the increasing success in the transplantation of the ureters into the sigmoid with the adoption of the general principles put forward by Coffey, there is rapidly appearing a relatively large group of patients whose reaction to pregnancy, operation, and disease has not been frequently observed. We feel therefore, that any contribution we might add at this time may be of value.

Until recently bilateral ureteral transplantation had been done chiefly for the relief of congenital deformities while less commonly inoperable ureteral vesicovaginal fistulæ, cancer of the bladder, and tuberculosis had been treated by this procedure.

In the University Hospital, we have had 26 cases of exstrophy of the bladder or epispadias during the past 10 years which required ureteral transplantation. Fourteen of these were operated upon while 11 were under 5 years of age and it seemed advisable to postpone operation. One patient was 60 years of age and a dangerous risk. It is interesting that 12 patients were females and 14 were males. Statistics from all other sources show that there is a marked predominance of males. In addition to this group of cases with congenital deformities, Cabot has transplanted the ureters in one case of cancer of the bladder, in two with irreparable damage to the urethral sphincter and in a fourth with intractable bladder pain. Peterson has recently reported two cases of inoperable vesicovaginal fistula treated in this manner. One of us (C.W.E.)transplanted a single ureter successfully for tuberculosis of the kidney and bladder. Of our 21 operative cases, 9 were adult females, all of whom might become pregnant. It is this group with which we are here chiefly concerned.

A review of the literature shows that pregnancy in patients with exstrophy is not as uncommon as might be expected. Miller and King discovered 14 reported cases up to 1918. Sage has since added another. There are only three cases of pregnancy reported in patients with transplanted ureters. One of these terminating in the birth of twins was reported by Charles Mayo; a second was reported by Knauf of the Mayo clinic; the third was recently observed by V. B. Green-Armytage. He successfully delivered a normal child by cæsarean section in a patient who had had ureteral transplantation done 14 years before by the Peters method. We add one case to this group.

In operating on our patient we observed the principles set down by Coffey for successful transplantation of the ureters. Though Coffey, C. H. Mayo, and Lower prefer the intrapelvic approach, we feel that the extraperitoneal method is safer and gives equally good results. The danger of infection which Lower emphasizes, in practice, is not great. Nineteen of our cases were done by this method during the past 10 years without serious infection. There was one operative death from unexplained rectal hæmorrhage, in a patient of 51 years.

We use the following technique as a rule: The ureter is approached through an oblique split muscle incision, the right side always being done first. As the peritoneum is stripped from the pelvic wall, the ureter will be carried with it. It is picked up at the bifurcation of the iliacs and mobilized to within a centimeter or two from the bladder, then cut across as low down as possible. The distal stump is tied. A 5 centimeter peritoneal incision is begun at the point opposite the fixed portion of the ureter. This will prevent kinking over the edge of the peritoneum. A loop of sigmoid is drawn through the peritoneal opening and a 3 centimeter incision is made through the longitudinal muscular band to the mucosa. The mucosa is then easily stripped back 1 centimeter on each side and a bed is prepared for the ureter. The preparation of the end of the ureter and its implantation into the bowel proceeds as described so frequently by Coffey and C. H. Mayo. In the closure of the muscularis over the ureter, we modify the technique slightly. It is impossible to compress the ureter against its mucosal bed by rolling in too much of the wall of the bowel in an effort to seal the wound. At the point where the ureter enters the muscularis at the proximal end of the wound, however, it may easily be shut off by drawing the full thickness of the intestinal wall over it. Coffey's tubes temporarily avoid this as does the strand of catgut used by C. H. Mayo. It may also be avoided if the closure of the muscularis is discontinued just at the point where the ureter enters it.

Fig. 1. The abdominal wall and external genitalia 3 weeks after cæsarean section for full term pregnancy in a patient who had had the ureters transplanted into the sigmoid 4 years before.

Since a leak here is possible, though rare if a rectal tube is kept in the bowel for a few days after operation, we allow about a centimeter of the bowel to remain exposed extraperitoneally and seal it off by suturing the peritoneum to the intestinal wall at one or two points. This also serves to fix the bowel and prevents pull on the ureter. The rest of the bowel is returned to the peritoneal cavity and the peritoneum is closed over it. A small gutta percha drain is left in the wound after it is first carefully washed out. Urine usually appears in the rectum at once. In a week or two the patient is ready for the second stage.

After an operation of this type our patient was promptly restored to society and within two years we were faced with the problem of marriage and later pregnancy. There were two important sources of danger. One, the deformity of the pelvis, the other renal damage due to the increased load under abnormal conditions. Williams says of split pelvis: "Owing to the descent of the promitory of the sacrum and the absence of union at the symphysis, there is marked transverse widening of the posterior portion of the pelvis while the anterior portions extend more or less parallel." He also observes that for practical purposes the pelvis may be considered as generally enlarged, the dystocia being due to abnormalities of mechanism resulting from the abdomen of a resistant anterior pelvic wall. Jellett agrees that "little or no difficulty is experienced during labor in consequence of the absence of any resistant force." Miller and King, however, found among their 14 cases recovered from the literature only four with fairly easy deliveries.

Fig. 2. Same as patient in Figure 1, showing details of external genital deformity.

A brief report of our case follows:

Four years ago Miss E. S. (120395), aged 19 years was admitted to the University Hospital for treatment of exstrophy of the bladder. Bilateral transplantation was done by one of us (C.W.E.) in two stages as described. The patient recovered without difficulty and married and within 2 years, in August, 1927, she re-entered the University Hospital, pregnant at term. The abdomen showed the normal distention of a full term pregnancy. The umbilicus was not present. A wide firm low midline scar marked the site of the exstrophied bladder. The two lateral operative scars through which the transplantation of the ureters was done were well healed and showed no signs of hernia. In the midline just below the fibrous symphysis and surrounded with dense scar tissue was the vagina which

Fig. 3. X-Ray of patient shown in Figures 1 and 2. Note the split pelvis.

admitted two fingers. It was 5 centimeters in length. The labia were widely separated anteriorly. At the symphysis there was a bony separation of about 4 inches. The antero-posterior diameter of the pelvis was normal, but there was a marked flare of the ilia, the interspinous diameter being 30 centimeters.

On the day following admission the patient began to have labor pains. Cæsarean section seemed indicated, because the absence of the anterior part of the bony pelvis might possibly cause a disproportion but chiefly because of the small vagina and the firm scar tissue surrounding it. A classical high Cæsarean section was performed by one of us (J.M.P.). At operation a deep depression was observed in the midline of the fundus suggesting a tendency toward bifid uterus. A normal 5½ pound female child presenting in the right occipito-anterior position was delivered. Convalescence was normal, the patient being discharged in 17 days. Throughout this patient's pregnancy there was no evidence of pyelitis or nephritis.

No conclusions can be drawn from one case, but, if we add this to the other three which have been reported, it would seem that transplantation of the ureters into the sigmoid does not contra-indicate pregnancy with a reasonable degree of safety. This is of particular importance to young married women in whom ureteral transplantation is indicated through irreparable sphincter damage or vesicovaginal fistula.

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THE PATHOGENESIS AND THE SURGICAL TREATMENT OF GASTRIC CRISIS OF TABES: NEURORAMISECTOMY[1]

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VISCERAL PAIN

A CONCEPTION of pain, the most human of sensations, is the least well established. To outline the theories concerning it would require pages; therefore, we will present only a few elemental points necessary for an understanding of certain attempts in modern surgery.

A preliminary question arises: Are the viscera sensitive? Lenander says that the vegetative fibers do not conduct painful impulses, there is pain only if the sensory nerves are irritated through the parietal peritoneum. Mackenzie also believes that the viscera do not have autonomous sensibility but that sensations are projected to the surface. Head believes that the viscera have protopathic, spatial, diffuse sensibility. Kappis thinks that the peritoneum, the omentum, the tissues which separate the organs, especially that which surround the vessels, are sensitive to pain, while Bruning, Goldscheider, and Breslauer believe that visceral pain originates at the level of the organ itself.

That a viscus does not react to a prick, a burn, or some other kind of stimulus does not prove that sensations of pain cannot take place in it, but simply that the adequate stimulus has not been applied.

A point on which everyone agrees is that in order to provoke a painful sensation, one must have an adequate stimulus, qualitatively and quantitatively abnormal, taking place at the level of the organ itself or of its afferent nerves. At the level of hollow organs, like those we are interested in, this stimulus is most often distention (Briscoe, Esmein, Lutembacher), spasm inflammation (Lemaire), or anæmia (Nothnagel). Distention and spasm are intimately associated according to the law of Bayliss-Starling: "All contraction of the intestine is accompanied by a relaxation of the preceding segment."

Abdominal irritation manifests itself by two types of pain: "One in the organ itself, which is more than discomfort and another at the surface of the body, which is a true painful sensation." The second type: the referred pain—localized most often in the corresponding cutaneous territory or in a more distant segment of the organ in which case the determination of origin is more difficult (Forgue).

The connections of ganglia of the sympathetic chain with the spinal centers explain the reference of pain in the metamere, and the displacement undergone by certain metameres during the evolution of the body explains certain paradoxic types of referred pain, but not all of them. The visceral excitation expresses itself by pain in the corresponding segment. The surface corresponds to the zone of Head.

Mackenzie has clearly demonstrated the reference of pain to the periphery, and his schema of conduction is well known: This viscerosensitive reflex which is not a reflex in the physiological meaning of the word takes the route of the cord. The English school of physiologists headed by Langley and Gaskell, agrees with the clinicians on this point.

The course of the sensory fibers is the same in all sensory nerves, that is direct to the cells of the ganglia of the posterior root without synapses in the peripheral ganglia. This touches on the much discussed problem of the central pathway of the sympathetic fibers. Mackenzie, Langley and Gaskell believe that this connection is through the spinal cord: the sensory neuron has its cell in the spinal ganglion and is connected with the sensory fibers in the cord through the posterior horn. This conception is the most frequently accepted and seems to be confirmed by the work of Edgeworth, Koelliker, and more recently of Rossi. Danielopolu and Lemaire basing their opinion on the morphological data of Ramon y Cajal, Dogiel, Edinger, believe that the synapse is located at the T cell of the spinal ganglion. The problem remains undecided but most of the recent investigations seem to confirm the conception of Gaskell (Ruiz Arna).

The recent experiments of Lemaire on the disappearance of certain visceral pains after the sensory neuron of the corresponding metamere has been anæsthetized adds support to Mackenzie's idea: the abolition of sensibility in the area of reflection immediately suppresses pain of the viscera. It does not prove that the relay between the sympathetic system and the cerebral nervous system takes place in the spinal ganglion. Admitting that this synapse has been demonstrated histologically, how could a referred pain be produced by direct irritation even if the impulse travels in a direction opposite to the

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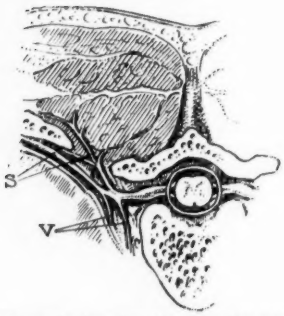

Fig. 1. Schematic drawing showing the position of the posterior root ganglion and the somatic and visceral rami.

functional polarization of the cell.[1] The experiment of Lemaire proves, and this is important, that the functional integrity of the conducting system is indispensable in the explanation of visceral pain.

Although we refrain from subscribing to any one of these opinions on the question, we suggest a possible conception of the mechanism of visceral pain: an adequate peripheral stimulus reaches the cord, puts it in a state of activity which serves to provoke exaggerated motor reactions in the organ concerned, leading to hyperfunction which rapidly exhausts it. Soon the muscles of this organ cease to be excitable; the viscus becomes distended, and the distention constitutes an obstacle to the passage of the impulse. The blocking of the impulses overloads the afferent sympathetic system, and results in stimulation of the corresponding spinal segment, expressed as contracture and pain in the respective metameres. The prolonged excitation of the spinal segment leaves behind it a state of local hyperexcitability.

This abbreviated sketch permits a better understanding of the mechanism of gastric pain.

GASTRIC PAIN

Pain originating in the parietal peritoneum is transmitted by the intercostal and phrenic nerves. Pain of the visceral peritoneum is transmitted by the major splanchnic nerve, except when it is in the descending colon and the sigmoid, when it is carried by the minor splanchnic nerve. The painful sensations of the stomach pass over the vagus (Max Kappis and Shauwer).

Operations to relieve gastric pain have necessarily been influenced by the prevailing ideas

[1] A. Verger has recently opposed similar objections to the conception of Lemaire. He recalls that paralyzing actions of anæsthetics are exerted only on the parts with which they are in contact, the nerve keeping its excitability above the anæsthetized point. On the other hand, he believes that the mode of junction of the two neurons at the level of the spinal ganglion remains unknown.

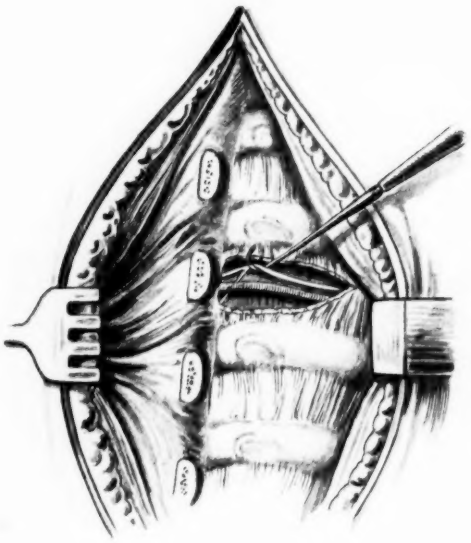

Fig. 2. A drawing to illustrate the method of approach. The intercostal nerves are raised by means of a hook. The artery lies below it.

concerning the conduction of visceral pain, that is, the possible site for operations to relieve pain range from the peripheral neuron up to the central nervous system.

To relieve visceral pain, Lemaire treated the sensory endings medically. Jaboulay attacked the peripheral ganglia with varied results. Danielopolu directed his efforts to the radicular segment. Sicard and von Gaza soon abandoned their efforts to obtain results by operation on the spinal ganglia. Von Gaza and Leriche depended entirely on operations on the rami communicantes. Frazier, Souttar, Foerster, Sicard, de Martel, and Robineau are all attempting to relieve pain by severing pathways in the spinal cord. This migration from the periphery toward the centers marks "the actual evolution of surgery of the sympathetic system and of the surgery of "pain."

THE SYMPTOMS OF GASTRIC CRISIS OF TABES

Notwithstanding the frequency of tabes, a serious clinical study of gastric pain in these cases offers interesting facts. One of us (Van Bogaert) has had the opportunity of following a great number of cases of tabes in a department of syphilology of the Belgian State and of collecting numerous histories.

PAIN

Clinical observation allows the grouping of the thoracovisceral pains in three categories:

Pain with metameric topography. The onset of the gastric or intestinal crisis has, in a great number of cases of tabes, a definite radicular character. Pain starts in the back near the vertebral column; it radiates laterally and reaches the epigastric or subumbilical region. There are lightning-like pains which follow each other rapidly for a rather short time, occasionally for a few hours. The seat of the pain is deep and definitely localized. The pain introduces or ends the true gastric crisis and is the thoracic equivalent of radiculitis of the sciatic type in the lower limb and of the cubital type in the upper limb. Study of sensation shows objective disturbances of a radicular distribution: hypoalgesia or hyperalgesia of the metameric areas corresponding to one or several roots.

The following case illustrates this kind of pain:

CASE 1. A woman, aged 38 years, received the initial syphilitic infection in 1908. Shooting pains were first felt in 1918. At this time the patellar and ankle jerks of the upper limbs were abolished. There was great ataxia; Romberg's sign was marked. Radicular pain corresponding to the seventh, eighth, ninth, and tenth dorsal segments was present on both sides. Hyperæsthesia to pain and to touch was marked, and the patient made mistakes in thermal appreciation. Myosis and anisocoria were present, the right pupil being larger than the left. The pupils reacted to light and to accommodation. Two gastric crises with radicular onset had occurred in 1923 and 1924.

Sympathetic pain "en nappe." In other cases, on the contrary, pain occurs spontaneously in areas of variable extension and indefinite limits without radicular or neuritic distribution. The pains are continuous, superficial, and undergo spontaneous exacerbations; they give the patients sensations of contusion, constriction, or crushing and resist most of the analgesic measures. These "sheets" of pain are usually situated in the epigastrium; sometimes at the level of the left hypochondrium, occasionally surrounding the right shoulder and, in some cases, in smaller patches near the vertebral column.

During the periods of extreme pain, the pilomotor reflexes are very acute; the patient screams at the slightest touch. At the level of the pains one may observe distinct, red, vasomotor lines. In certain cases the injection of pilocarpine increases the pain and in two of our cases provoked sudation over the hyperalgic area.

Clinically these pains recall the true sympathalgias, and, although we reserve judgment as to whether or not there is a pain belonging specially to the peripheral sympathetic fibers, we believe that it is possible that they have their origin in the irritation of the afferent path of the sympathetic system. The following cases illustrate pain "en nappe."

CASE 2. A woman, aged 46 years, gave no history of hereditary syphilis.[1] She had given birth to ten children, six of whom were living and well; there had been three miscarriages. The data of syphilis infection was not known. The present illness began 4 years previously, with headache and diffuse pain of a rheumatoid type affecting the superior and inferior limbs. The chief complaints were shooting pains, trouble with hearing, slight dysuria and decrease in vision.

On examination the patient's walk was found to be slightly ataxic, and stiff. There was marked tremor of the upper limbs and of the tongue. The tendon reflexes of the upper limbs were well marked on both sides, the patellar and ankle jerks were abolished. At the level of the lower limbs and in the subumbilical region there were disturbances of deep and superficial sensation, especially tactile and thermal. There was a degree of sensitiveness of the bone. Paroxysmal pains "en nappe" of a sympathalgic character, occurred in the region of the epigastrium and of the left hypochondrium. Perianal pain was present. There were areas of hyperæsthesia to touch and pain at the level of the sacrum and in an oval above the left breast. The injection of 40 per cent iodized oil showed that there was no obstruction in the spinal canal. Myosis and anisocoria were present, the right pupil being larger than the left and irregular. Reaction to light was abolished on both sides. The Bordet-Wassermann test was slightly positive in the blood.

CASE 3. A man, aged 40 years, had contracted the initial syphilis infection in 1903. The onset of the present illness was characterized by shooting pain in the lower limbs and vesical crisis. For 2 years there had been extremely hyperalgesic plates in the epigastrium, the left hypochondrium, and the left flank, and pains of the causalgic type in the right shoulder. These pains were not relieved by any analgesic. The patient suffered from crises of the crushing type, in the epigastrium. During the crises a red line followed stroking in the region of the epigastrium. The patellar, ankle and mediopubic jerks were abolished. All abdominal cutaneous reflexes, with the exception of the cremasteric, were preserved. The eyes were unaffected. The Bordet-Wassermann test in the spinal fluid was positive. Twelve cells and albuminose, 0.55, were present The Pandy and Weichbrodt reactions were positive.

Shaw also distinguishes a dull, vague and constrictive pain which does not correspond to the sympathetic pain just described and which does not disappear after posterior radicotomy.

Deep gastric pain. Deep gastric pain has been well described and is known to all clinicians. The painful reaction is intimately bound up with sensory motor reactions (nausea, vomiting, and gastric hyperkinesia), but pain may exist alone, and in that case takes on the aspect of true classical splanchnic crisis.

DIGESTIVE SYMPTOMS

Nausea and vomiting are the predominant digestive symptoms. The nausea may be extremely

[1] Marked scoliosis and lordosis with pain appeared when the patient was 17 and the pain and malformation increased markedly during her married life.

troublesome; it may occur alone for several hours before the painful crisis or the vomiting itself may constitute the entire gastric crisis, the vomitus being finally reduced to bile-tinged sputum. In certain cases, nausea is associated with migraine, hemicrania with terebrating pain in the temporoparietal region, intense and dull occipital pain, recalling at times that of tumor of the posterior cerebral fossa. One of the patients on whom we operated had been complaining of nausea alone, sometimes persisting for 3 or 4 days.

Ordinarily in true gastric crisis, vomiting is a prominent symptom; it is uncontrollable, sometimes spasmodic, and coincides most often but not always with a nauseous state. Sometimes one meets with nausea without vomiting and less exceptionally with violent pain not associated with gastric intolerance.

The mechanism of the vomiting is complex: in a certain number of cases we have been able to verify, on the fluoroscopic screen, existence of spasm of the pylorus with intense peristalsis and antiperistalsis so marked as to force the cardia almost mechanically. In other cases, however, there was a flask stomach. The nauseous excitations may be bulbar in origin and, indeed, it is difficult to admit that increase in abdominodiaphragmatic pressure by radicular irritation may not by itself precipitate the reflex of vomiting. These cases are exceptional and in the majority of instances digestive hyperkinesis is the rule. One frequently observes prolonged spasms of the small intestine and of the right colon, and constipation is often noticed.

HICCOUGH

Hiccough is relatively rare in the very painful forms of crisis with vomiting and in the crisis of nausea. A typical case is reported in which the gastric crisis manifested itself only by deep pain in the right hypochondrium, a dull ache in the right shoulder and shoulder blade, and persistent hiccough during several days, resisting all therapeutic measures. The case has been followed for 4 years and not once has there been any vomiting or nausea.

CASE 4. A man, aged 41 years, contracted the syphilitic infection in 1909. In 1916 there was transitory palsy of the right rectus externus, in 1917, shooting pains in the lower limbs and transitory urinary incontinence; and since 1920 complete impotence. The patellar and ankle jerks were abolished. There were occasional, encircling, radicular pains at the level of the twelfth dorsal and first lumbar segments. Since 1920 there had been very severe painful crises in the deep epigastric and periumbilical region, radiating rapidly to the right hypochondrium and the right shoulder. These attacks were accompanied by hiccough from the very first hours, and always produced the same syndrome, except that in the most severe crises pain reached the right side of the neck as well. At operation in 1921 the stomach and gall bladder appeared normal. Two crises in which there was gastric hyperkinesis were observed in 1924.

NEUROVEGETATIVE TROUBLES

The gastric crisis of tabes is essentially an irritative syndrome of the afferent gastric paths and, therefore, the two great vegetative arches, the sympathetic and the vagus, must be considered in dealing with the disorder. There are two great varieties of gastric crisis of tabes: sympathetic and vagal. We were interested in determining if there is a particular mechanism for each variety and, consequently, a particular form of treatment.

Does the state of the patient's vegetative system precipitate or influence the course of the visceral crisis? The question is not new. Wiart, Levy, and Hartgals have described a sympatheticotonic form of tabes, with arthropathy, visceral anæsthesia, permanent tachycardia, and abolition of the oculocardiac reflex. Harvier believed vagotonia was responsible for the laryngospasms, abdominal pain, paroxysms with sialorrhœa, gastrorrhœa, and so forth.

We have tried to review this question systematically. One agrees with most of the clinicians of today in considering the vegetative equilibrium of an individual at a certain time, as the expression of integrative action of the sympathetic and parasympathetic nervous systems (Danielopolu). The pathological vegetative phenomena result from a series of disturbing factors including (1) a modification of the normal amphotropism of the medium, (2) a local lesion of the organs, (3) a lesion of the extravisceral or other efferent nervous paths able to influence the vegetative functions, and (4) the functional state of the afferent routes.

It is evident that the last three factors play a manifest rôle in tabes. The lesions of the organs strongly influence the local tonus, the terminal ganglia, the sympathetic or parasympathetic endings, and the intervisceral connections. On the other hand, lesions of the cortex and of the paths which join the cortex to the vegetative centers modify the reactions of these patients. It is evident that one cannot appreciate the value of each factor separately.

We have chosen three tests: two very reliable ones (administration of atropine), the other more complex and less conclusive (intravenous injection of epinephrine).

The courses of four cases have been studied for more than 2 years: three of the patients were

amphotonic and one vagotonic. The behavior of the amphotonic patients followed the rule formulated by Danielopolu: "In amphotonia the hypertony predominates upon the excitors whether they are represented by the sympathetic (heart) or by the parasympathetic (digestive tract)." In two of these cases studied during gastric crisis, it was seen that the amphotonia was increased for the two groups except for two symptoms for which we see no explanation: arterial and venous hypotonia. A patient of the vagotonic type behaved during the crisis like an amphotonic patient with sympatheticotonic predominence. What practical data may be drawn from these laborious researches of which we shall not give all the details? The facts are interesting in themselves as they show the unruliness of the vegetative system during the visceral paroxysm, but it shows also that it does not always influence the vegetative reaction and that consequently no matter how detailed these data on the vegetative system are, they cannot constitute a criterion in choosing whether intervention shall be in the sympathetic or vagal system. A few clinical signs which we will mention seem to us to be of greater value.

The pharmacodynamic tests are no more final. Crises which are relieved by epinephrine are sympathetic in nature (Heile); those temporarily relieved by atropine are vagal in nature (Thomsen). However, in experimenting on cases chosen because they are rather definite clinical types of vegetative disorders, we have been surprised before beginning our systematic research to find that within a few days the same patient had been helped and made worse by epinephrine given under almost analogous conditions. For this reason we have abandoned pharmacodynamic tests to determine the type of intervention required.

We wish to compare some of these clinical facts just reported with a few data found in the literature. We have shown that the radiculogastric evolution of the crisis has been remarkably well described by Head and Fearnside. On the other hand, Foerster, Cotte, Jean, Critchley and Wolfsohn have differentiated the vagal crisis from the sympathetic crisis in experiments on the biological reactions of the gastric juice, and it is evident that a similar interpretation should explain in certain cases the benefit obtained from radicotomy and vagotomy and in certain other cases the complete failure. In a recent work, Foerster insists again on that differentiation and its importance in deciding the type of operation. He would utilize the radiculospinal operation for the splanchnic crisis and section of the sensory root of the vagus (technique of Foerster-Kuettner, for the vagal forms. The tenth nerve has a mixed sensory and motor root.

Since 1911, Foerster has suggested the importance of the phrenic nerve in certain gastric syndromes of tabes. More recently he has completed his research and has concluded that affection of the phrenic causes a special type characterized by pain in the shoulder, hyperalgia of the neck, and hiccough. This form does not include nausea or vomiting. Case 4 of our series justifies the separation of such a type at least from a clinical standpoint.

The general impression which we can draw, however, from our observations is opposed to a too strict separation of the different types: sympathetic, vagal, and phrenic. In most of the cases, one finds symptoms belonging to three categories; the study of the vegetative tests shows the confusion of the two systems in the disequilibrium, and the pharmacodynamic tests of Heile and Thomsen do not solve the problem. We will see later that we can draw similar conclusions from cases in which we have operated.

THE MECHANISM OF GASTRIC CRISIS OF TABES

The gastric crisis of tabes is essentially an irritative syndrome of the afferent paths of the stomach, either at the level of the spinal roots or at the level of the root of the vagus.

It is still undecided whether the stomach or any other abdominal viscus possesses true sensory fibers. However, it is certain that the majority of the connectors of the gastric sensibility pass through the solar plexus, the splanchnicus major, the ganglionic and vertebral chain, the white rami, and reach the cord through the dorsal roots from the sixth to the tenth, or even the eleventh and twelfth.

At present there is no proof in favor of or against the existence of sensory fibers of pain in the trunk of the vagus. The failure of Exner's subdiaphragmatic vagotomy in the treatment of gastric crisis of tabes does not testify, as Foerster says, against the possible rôle of this nerve in the sensibility of the stomach. We know, indeed, that in the gastric crisis of tabes the painful irritation is not in the subdiaphragmatic segment of that nerve but in the root itself. The resection of the root alone (Foerster-Kuettner's operation) could make us decide on the rôle of the vagus in the sensibility of the stomach. Neither is it known whether the phrenic nerve contains any pain fibers from the stomach but clinically it seems to.

The topographic mechanism of pain as a symptom is thus elucidated. To explain vomiting, one may admit an excitation of the vagus reaching the bulb and referred toward the periphery by the thoracic roots (influencing the diaphragm and the abdominal muscles), by the splanchnic nerve (innervating the stomach), and by the vagus (innervating the cardia). However, we do not exclude strictly local reflexes at the level of the gastric mucous membrane itself, hypersecretion and vomiting going on even after suppression of all the afferent paths.

Gastric hyperkinesis evidently depends on stimulation of motor fibers at the level of the spinal roots as well as at that of the terminal ganglia. Nausea is a vagal syndrome and is probably caused by the excitation of the centrifugal root.

Our knowledge of the metameric levels corresponding to different nerves affected in gastric crisis is relatively precise. The afferent and the efferent fibers from the stomach seem to enter the cord through the roots from the fifth to the twelfth dorsal. The fibers belonging to the phrenic nerve arise from the third, fourth, and fifth cervical segments. The topography of the vagus is known.

Our knowledge of the segmental distribution of the cord dictates our surgical procedure.

Foerster called attention to the important rôle of the posterior root in the mechanism of gastric crisis. Posterior radicotomy of even a large number of roots has not been uniformly successful.

Therefore since 1911 Foerster has begun to resect the anterior roots. The rôle of the anterior roots in the conduction of sensibility has been sustained by Kidd (1911), Lehman (1920), Foerster (1920), Lehman (1920), Head and Shaw (1922), Foerster (1924), Shaw (1925), Critchley and Wolfsohn (1926).

An extreme view is held by Lehman who believes that the anterior root alone conducts deep and visceral sensibility. This theory has been enthusiastically discussed by Frohlich and Meyer, Weizaecker, Mueller, Meyer and others. New research work on the subject has just been published by Meyer. His conclusions are very positive: The law of Bell holds true in man and all experimental work tends to prove that the sensibility goes exclusively through the posterior roots.

However, Foerster expressed himself as follows: "The anterior and posterior roots contain the afferent paths. The posterior roots constitute the principal sensory system; section of them constantly results in the production of sensory disturbances, provided a sufficient number of roots has been sectioned. The anterior roots constitute an auxiliary pathway of sensibility, their interruption alone never provokes any appreciable sensory disturbance. However, the fibers of the anterior roots may, in a certain measure, cover the sensory deficit resulting from destruction of the posterior roots. This compensatory action applies chiefly to deep sensibility but also in a less degree to cutaneous sensibility." The experiments of Shaw confirm the veracity of Foerster's opinion.

It seems, however, that the anterior and posterior roots are not alone concerned in transmitting visceral sensibility. Foerster who has had great experience in operating on patients with tabes, has come to the conclusion following examinations made on patients in whom the posterior and anterior roots and even the lateral spinothalamic tract had been cut, that there must also be an extraradicular route by which pain stimuli may reach the central nervous system. He explains this as follows: "One must think of the possibility of pain stimuli being conducted from the stomach by way of the periarterial sympathetic plexus of the gastric vessels, the aortic plexus, the sympathetic trunk, and from there to the cord by the corresponding rami communicantes (eighth cervical to third lumbar roots)." As we have previously mentioned the question of whether or not the vagus carries painful impulses remains open.

THE RESULTS OF VARIOUS SURGICAL INTERVENTIONS

The peripheral operations (extirpation of the solar ganglion by Leriche, elongation by Jaboulay, isolation by Delbet and Mocquot) only partially remove the afferent and the efferent pathways.

Resection of the splanchnic nerves purposed by Jean and executed by Foerster, and section of the rami cannot be depended on to effect a cure.

Section of the posterior and anterior roots combined with cordotomy is certainly the operation of choice in crisis with sympathetic predominance.

As far as vagal crises are concerned, subdiaphragmatic vagotomy is ineffective; section of the roots of the vagus proposed by Foerster-Kuettner has not been done sufficiently often to permit one to pass judgment on its merits. In one of our cases of the vagal type, amelioration obtained by section of the thoracic roots has been so remarkable that for the time being we have decided to discard the various operations on the vagus nerve.

We have so far not had the opportunity of operating in a case of crisis of phrenic type and do not know that this operation has been carried out elsewhere.

After what we have said about the participation of the anterior roots, the posterior ones and perhaps the ganglionar chain in the conduction of gastric pain, it is obvious that both roots must be sectioned. This is accomplished by Foerster through the intradural route. We have tried to perform it by an extravertebral route which produces less trauma by combining section of the intercostal nerves with that of the rami communicantes in the paravertebral line.

THE TECHNIQUE OF NEURORAMISECTOMY

This technique for neuroramisectomy was suggested by that of Gaza. The patient is placed horizontally in ventral position with a pillow under the inferior portion of the thorax. The dorsal spinous processes are carefully located. If they cannot be palpated because of obesity, one may readily orient himself by the stunted nodular structure of the transverse processes of the last dorsal vertebræ after incision. In almost all the subjects which we have examined, atrophy of the transverse process of the eleventh dorsal vertebra was well marked.

The operative field is disinfected. At about 3 centimeters outside the spinous processes, one cuts successively the fascia of the latissimus dorsi, the inferior fibers of the trapezius, the latissimus dorsi, and the superior fibers of the small serratus posterior inferior. The muscles are then retracted, and one may view the transverse processes to which the numerous small muscles of the back are attached. These transverse processes are carefully cleaned with scissors and periosteal elevator. The next step consists in severing these processes as near as possible to the vertebral laminæ and detaching them from their costal articulations. This step may provoke a certain amount of bleeding which comes from the posterior branches of the intercostal artery. In order to check this it is advisable to place a swab in the space thus created while one severs the process situated above or below.

The intercostal nerve is next located. To do this one cuts the fascia of the external intercostal muscle and enters the space situated between the internal and external intercostal muscles in which one finds, mixed with fat and loose connective tissue, the intercostal nerve with its vessels, liberates it with a probe and holds it on a hook. The next step consists in isolating the rami. In order to do this, the intercostal nerve must be slightly stretched; one must stretch it only slightly in order to avoid injuring the cord.

By cleaning the intercostal nerve carefully with a probe, one discovers the rami and often the spinal ganglion with the outer portions of the spinal roots. It is advisable to touch with the probe only the tissues which one sees so as to avoid injuring small veins and arteries nearby. One next resects the rami and the adjoining portion of the intercostal nerve. A few interrupted sutures will serve to join the muscular tissues, and the skin may be sutured as the surgeon prefers.

ILLUSTRATIVE CASES

CASE 5. A man received the initial syphilitic infection in 1915. In 1919 he experienced uncertainty in walking and vesical symptoms. These manifestations were progressive. In January, 1920, root pains of the shooting type appeared but were interpreted as sciatic pain. By 1922, the shooting pains had become marked in the lower extremities and were accompanied by a feeling of uneasiness in the epigastrium and a sensation of swelling deep in the area of the stomach and the left hypochondrium. In 1923, there were a few very painful crises in the right hypochondrium and troublesome, bilious vomiting.

When examined in 1925, the patient was 34 years of age and in poor health. There was a general absence of tendon reflexes. Babinski's and Oppenheim's signs were present on the right; the cremasteric and abdominal cutaneous reflexes were absent. Ataxia in the lower extremities was marked. The patient frequently suffered from vertigo.

Ophthalmic examination revealed pupils of medium caliber; on the left the Argyll Robertson sign was incomplete, on the right it was complete. Headache was common. From a psychic standpoint, the memory was failing, and there was definite lack of interest; the patient was querulous. The stomach was dilated and there was diffuse tenderness in the epigastric region. Pain was present in the region of the gall bladder, but the viscus was not palpable.

The gastroradicular type of crisis predominated in the case. The crisis was extremely severe and lasted for several days during which the patient could not take any food. Nausea and vomiting were continuous and resulted after painful efforts in the evacuation of bilious liquid. Between the crises, appetite was absent, and if the patient made an effort to eat, pyrosis and often vomiting followed, sometimes provoking a fresh crisis. On certain days the pain was localized in the right hypochondrium, there was nausea without vomiting, a tendency to fainting spells, and hemicrania or bilateral temporal pain.

Between September, 1925, and January, 1926, attempts were made to relieve these crises by various forms of treatment. Salvarsan, stovarsolepinephrine, bismuth milk intramuscularly, and phalogetan combined with tuberculin were tried without success.

At neurologic examination in November, 1925, it became apparent that an area of hypæsthesia from the tenth dorsal to the second lumbar cutaneous areas, with an area of hyperæsthesia above it, the inferior border of which shifted from day to day. In the hypæsthetic area even very strong electrical stimuli were without effect but a certain sensitiveness to heat persisted. There was generalized diminution of sensitiveness of the nerve trunks and of the viscera on pressure. On the left there was evidence of a

beginning Horner's syndrome: enophthalmos, diminution of the palpebral fissure and mydriasis. Pallæsthesia on the lower limbs was suppressed, and marked hypotonia was present. Syphilitic myocarditis with instability of the tension and periods of arrythmia was evident. There was hepatic and renal insufficiency.

The possibility of operation was considered in this case and injections of novocain were used to determine the nerves that controlled the pain. April 18, a bilateral paravertebral injection of 100 cubic centimeters of 1 per cent solution of novocain was given at the level of the seventh, eighth, ninth, tenth, and eleventh dorsal roots. Almost immediately tingling and prickling appeared in an area corresponding exactly to the seat of the preceding crisis. The patient experienced a sense of well-being for the first time after weeks of suffering. During the next 4 days he was able to work and eat; the change in his condition was surprising. He went without morphine, which he had been taking in large amounts. During the night between the fourth and fifth days he became nervous and noticed a feeling of heaviness in the epigastrium. April 23, the crisis recurred as violently as before, with intense pain, vomiting and loss of appetite. April 26, an injection of novocain, similar to the first, gave the same relief. It was as complete as after the first, but lasted only for 8 hours. The patient threatened to commit suicide and was very anxious to undergo an operation which offered possible relief. Although the patient was cachectic operation was considered advisable.

May 14, the dorsal roots of the eighth, ninth, and tenth nerves and the corresponding rami on the left were severed. Except for slight relief of pain, the patient's condition was not improved and the vomiting was as violent as before. Examination revealed superficial and deep anæsthesia on the left, corresponding to the eighth, ninth, and tenth dorsal roots, hypæsthesia to pain and touch in the space of Traube and in the back at the level of the seventh dorsal nerve.

May 28, the second stage was performed. The seventh, eighth, ninth, and tenth dorsal nerves on the right and their rami were severed. The same day the visceral symptoms and shooting girdle pain ceased, only a slight pain at the level of the right shoulder persisted. Neurologic examination showed superficial and deep anæsthesia corresponding to the seventh, eighth, ninth, and tenth right dorsal nerves, in addition to the area of anæsthesia previously observed on the left, not reaching the median line.

For 3 weeks the patient seemed better, he was definitely relieved of pain. However, later he grew weaker and diarrhœa developed. Cachexia increased and the patient died, apparently from general asthenia.

In this case, we had to deal with advanced tabes with thoracic radicular crisis, gastrovesical crisis and sometimes vesical crisis of the vagal type. All medical measures failed to bring about relief. The state of nutrition was extremely poor. Bilateral paravertebral anæsthesia suspended all the trouble immediately, the first for 5 days, the second time for 8 hours. Section of the eighth, ninth, and tenth dorsal roots on the left and the rami did not modify the root pain, the sympathetic pain or the gastric crisis in the least. Section of the seventh, eighth, ninth, and tenth dorsal nerves and rami on the right caused an instantaneous disappearance of the pain which was continuous for more than 3 weeks.

Case 6. A man, aged 46 years, was first seen by us in February, 1925. The date of the syphilitic infection was unknown. Since 1918 the patient had been treated for gastric troubles (acid dyspepsia); later for gastrohepatic symptoms and constipation and finally for cholecystitis. At operation the gall bladder appeared normal. Shortly after this operation and a few days before we saw him, typical radicular crisis appeared and the presence of the Argyll Robertson sign and myosis was noted.

At examination the abdominal cutaneous reflexes appeared to be preserved. The Romberg sign was not marked. The patellar, ankle, and cutaneoplantar reflexes were absent. All reflexes of the upper limbs were normal. Bilateral myosis and Argyll Robertson's sign were present. Urobilin and biliary pigment were found in the urine. Reoch's test was frankly positive, and the elimination of blue markedly retarded.

Following intensive treatment with neosalvarsan, there was a slight transitory diminution in the vesical crisis. Between April and October, 1925, there were several crises of biliary vomiting with pain sometimes of a vesical and sometimes of an abdominal type. When the crisis was abdominal, there was a preliminary period of marked constipation, followed by glairy diarrhœa, sometimes bloody, and violent appendicular pain radiating toward the stomach and the left hypochondrium. On two occasions we attempted to relieve the crises by duodenal lavage with the Einhorn tube and large doses of magnesium sulphate. These measures relieved the crises only for a short time and never ended them. From January to April, 1926, tryparsamide (3 gm.) and intramuscular injections of salicylate of mercury (60 cgm.) were given at intervals of 5 days. March 25, it was necessary to interrupt this treatment on account of diminution of vision. The treatment was later resumed.

Notwithstanding this energetic treatment the gastrovesicular crises returned in a more severe form in April, 1926. Medical treatment was abandoned. The vomiting was unbearable. Even in periods of remission, nausea was continuous, the mouth was pasty, the tongue dry, and loss of appetite was marked. Pain was moderately intense, but of sufficient severity to interrupt sleep on several occasions. The pains were visceral and radicular and were confined to the lumbar region and the right hypochondrium. The patient was very anxious to undergo operation even though the hope of success was not great.

April 28, the intercostal nerves, including the rami, at the level of the seventh, eighth, ninth, tenth, and eleventh dorsal roots were severed, following the technique described. The immediate relief of pain was striking. There was no nausea, even though the patient had been anæsthetized with ether and chloroform during the operation, but he complained of a disagreeable sour taste and a pasty feeling in the mouth and throat. For 2 days there were pains in the right shoulder, which were relieved by change of posture. The patient was up on the fourth day.

The cure appeared to be complete and for 3 months the patient was absolutely without nausea, ate with appetite, and resumed his work. There was a slight tingling and numbness in the right hypochondrium and rheumatic pain in the back, in the field of operation. At the end of July, the patient suddenly began to vomit again. Crises reappeared in the same form and intensity as before operation. Magnesium sulphate and morphine gave transitory relief. Only the injection of novocain at the level of the fifth and sixth dorsal roots on the right suppressed pain and vomiting completely, then only for 36 hours. A second operation was proposed.

The intercostal nerves, including the rami, were severed at the level of the fifth and sixth dorsal roots on the right.

Convalescence was uneventful, and the patient was up on the fifth day.

A year after the first operation the patient appeared to be in excellent health. There was slight hypotonia of the muscles of the abdomen in the right hopochondrium with pilomotor areflexia and cutaneous anæsthesia to pain and heat. There was a marginal area of hyperæsthesia in the area innervated by the sixth dorsal.

In this case, we had to deal with gastrovesical and sometimes intestinal crises which dominated the clinical picture. Section of the seventh, eighth, ninth, tenth, and eleventh dorsal roots and rami on the right brought about immediate relief for 3 months. Because of the recurrence of the gastric crises, we performed a similar operation on the fifth and sixth dorsal roots. The troubles disappeared entirely and the cure has persisted for more than a year.

Case 7. A woman, aged 59 years, was married but had never been pregnant. Her husband had died recently following general paralysis. The date of the patient's syphilitic infection was unknown. The present illness began in 1920 with pain in the lumbar region which increased in intensity and frequency until it was typical of true severe crisis. For more than 5 years these pains resisted all kinds of therapeutic measures and there was not a week in which they did not occur. At the onset of the attacks there were eructations, gastric heaviness and nausea for several hours but no vomiting and no real gastric pain. However, these premonitory symptoms inspired terror, because they were invariably followed by the true painful crisis, characterized by violent shooting pain in the back, from the sixth to the tenth dorsal vertebræ, the pain radiating laterally, to the axillary line and never reaching the gastric region. The pain was much more marked on the left than on the right. During the crisis, which might last from several hours to several days, the patient remained in bed and had absolutely no desire for food. Since 1920 constipation had been marked. The patient was emaciated and of a subicteric color.

On examination, the Argyll Robertson sign was observed. There was hyperæsthesia in a region corresponding to that in which there was subjective pain; the patient was able to give the limits of this area with surprising accuracy. The knee jerks were abolished; the right ankle jerk was weak. Romberg's sign was absent, and there was no appreciable ataxia.

In order to determine the origin of the pain, we injected a 0.5 per cent solution of novocain into the paravertebral spaces in which the pain was maximal, that is, from the sixth to the tenth dorsal nerves on the left and from the seventh to the tenth dorsal on the right. The stomach was observed by means of the fluoroscope before and after the injection. Before injection ptosis was marked, the stomach was hypertonic, emptied rapidly and a large air pocket was evident. After injection gastric motility was diminished, and the passage of food through the pylorus was slow.

At operation, November 26, the sixth, seventh, eighth, ninth, and tenth dorsal roots and the rami on the left were severed. The effects were striking and immediate. Convalescence was uneventful and the patient was up 5 days after operation.

Six months after operation the violent pain on the left side had completely disappeared; the pain on the right side had also vanished, except on two occasions on which there was only slight pain accompanied by the usual gastric symptoms. There was a region of hyperæsthesia on the left side with slight prickling in the area innervated by the nerves severed at operation. The patient's appetite was good, the tongue was clean and the pasty taste was gone from the mouth. The constipation had disappeared and the bowels moved easily and regularly. Since operation the patient had gained 16 pounds and has been able to work.

In this case the predominance of root pain was marked, visceral disturbances being only faint and introducing the crisis. Severing the sixth, seventh, eighth, ninth, and tenth dorsal roots on the left (the most painful side) with the rami suppressed the pain on the left side entirely and on the right side almost entirely but it did not improve the slight gastric disturbance.

CONCLUSIONS

Surgical measures in the treatment of gastric pain have, generally speaking, dealt on the one hand with the organ itself and on the other with the paths through which the painful impulses were thought to be reflected in the respective metameres.

These ideas may be applied to the gastric crises of tabes more than to any other pain. Clinical analysis of this type of pain reveals a radicular factor, superficial and deep sympathalgic elements and possibly vagal or phrenic participation. It is the uncertainty of these factors which may explain the failure to provide relief in all cases.

Clinical or pharmacologic criteria which would enable one to estimate the part played by these various factors and thus to determine appropriate treatment apparently do not exist. Clinical study leads us to make certain assumptions, but efforts to determine the state of the neurovegetative equilibrium have not given us faithful results.

From a practical point of view, the majority of tabetic crises are vagosympathetic in type.

From an anatomophysiological standpoint, the tabetic crisis is an irritative syndrome of the gastric afferent paths, either at the spinal roots or at the roots of the vagus. The posterior spinal root plays the chief rôle, but we cannot exclude the anterior root from participation in this process through its sympathetic fibers. The part played by the sensory fibers in the vagus is still unknown.

A physiological operation for the relief of tabetic gastric crisis (since the participation of the vagus nerve is still unknown) should thus be directed toward the posterior sensory root and the sympathetic fibers of the anterior root: the combined section of the two roots and the resection of the rami answers these requirements.

It constitutes the neuroramisectomy which we have performed by an extra-medullary route. It is indicated in all crises of vagosympathetic character.

We have had no experience of its results in crisis of pure vagal or phrenic types. Do these require operations of another type for their relief? We do not know. *A priori* nothing contraindicates a trial of neuroramisectomy.

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THE FELTER YOKE AS A PROPHYLACTIC MEASURE FOR POSTOPERATIVE PRESSURE PARALYSIS FOLLOWING THE USE OF THE TRENDELENBURG POSITION[1]

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DURING the last part of the nineteenth and the first of the twentieth century, paralyses thought to result from anæsthetics and narcotics were discussed at some length by many writers, both in this country and abroad. Since 1908, however, there is very little available literature on this subject, not because this condition has ceased to exist but because the majority of writers have agreed both as to the etiology and the best prophylactic measures to prevent such surgical accidents.

It is not the purpose of this article to contradict previous claims or to present any new theories as to the etiology of these paralyses, but merely to describe three cases resulting from pressure of shoulder supports while the patients were in the Trendelenburg position, and to offer the Felter yoke as a prophylactic agent.

Buedinger was one of the first to describe cases of paralysis of one or more extremities following operation. He reported 9 cases in 1894, followed in a short time by 3 more. In 1895, Krumm reviewed the subject and referred to articles by forty separate investigators. From then until 1908 many other reports may be found.

In discussing this condition the majority of writers agree that it is avoidable and that the most important prophylactic measure is the correct position of the arms during the operation, namely, at the side, or crossed upon the chest. There were a few, Green, for instance, who argued that the paralysis was not due to pressure but to the direct toxic action of the anæsthesia. He reports a case of complete paralysis of the right upper extremity following operation for cholelithiasis performed under chloroform and points out that the arms were folded upon the chest throughout the operation.

The two types of paralysis which must be considered are the central and the peripheral. The former is quite rare and is due to an ischæmic softening secondary to a hæmorrhage, or to a primary degeneration, the result of a toxic action of the anæsthetic upon the cerebral cortex (Halstead). Hersman expresses the view of the majority, however, when he says: "Paralyses following an anæsthetic which are due to that agent alone are more imagined than real."

It is the other type, the peripheral, and especially that of the brachial plexus that comes within the scope of this article. Undoubtedly the position of the arms is an all important matter, as most of the reports state that the arms were displaced, upward and backward over the head during the operation. With the arm in such a position, the clavicle is drawn upward with a resulting compression of the cords of the brachial plexus between the clavicle and the first rib. With marked abduction of the arm, the clavicle rotates so that its posterior superior border becomes its posterior inferior border and in this way decreases the available space between the clavicle and the first rib.

Other conditions that predispose to a postoperative paralysis, as pointed out by Leszynsky, are: extension of the head toward one side, thus stretching the nerve trunks; the position of the arm under the head or body during a long operation; the position of the arm or leg over the sharp edge of the operating table, thus causing pressure on one or more of the peripheral nerves; pressure on the part of the anæsthetist with fingers or elbows upon the region of the brachial plexus; and finally pressure from metal clamps or tight straps over the shoulders or lower extremities. Our cases all fall into the last group, as in each case the arms were folded upon the chest, and metal braces were used to support the shoulders.

Many believe that the Trendelenburg position is responsible for the majority of these paralyses, not, as we have found, because of excessive pressure from shoulder supports, but more often because of the tendency for the arms to be displaced over the head and also because of pressure upon peripheral nerves caused by contact between the sharp edge of the operating table and the popliteal space. The last can be prevented if the patient's weight is allowed to be almost entirely supported by the shoulder supports, which necessitates the use of accurately fitting shoulder braces. Leszynsky reports a case in which the paralysis was caused by a strap tightly fastened over the shoulder. This case more closely resembles ours than any other found. The practice of drawing the patient up on the

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Fig. 1. Operating table with yoke attached, showing method used for adjusting position of yoke to fit shoulders.

Fig. 2. View of yoke from end of table, showing metal uprights in position.

operating table by traction in the axillæ is responsible for a small percentage of these palsies and should be discouraged.

The point at which the brachial plexus is compressed varies, as can be seen in the difference in the resulting paralyses. It may vary from the compression of a single cord to a compression of all of the trunks of the plexus. The fifth and sixth cervical roots are more often involved, as they cross the first rib, causing an Erb's type of palsy involving the deltoid, clavicular portion of the pectoralis major, brachialis anticus, biceps, supinator longus, and not infrequently the supraspinatus and infraspinatus muscles (Turney).

Fig. 3. Patient supported by yoke. Arms are folded on chest during the operation.

Fig. 4. View of patient in deep Trendelenburg position, showing even distribution of pressure upon the shoulders. As in Figure 3 the arms should be folded upon the chest.

The point at which pressure will cause this injury is located one inch above the clavicle at the posterior border of the sternocleidomastoid muscle. The seventh and eighth roots may be damaged in the same way, or by being stretched over the head of the humerus.

Case 1. Mrs. E. M. G., aged 45; married; weight, 135 pounds; mother of 5 children; entered the hospital on November 22, 1926, because of abdominal pain and menorrhagia. Examination showed the fundus to be larger than normal and revealed a mass in the right broad ligament. On November 30, 1926, the patient was operated upon, and a panhysterectomy and bilateral salpingo-oophorectomy were performed for a tubo-ovarian abscess.

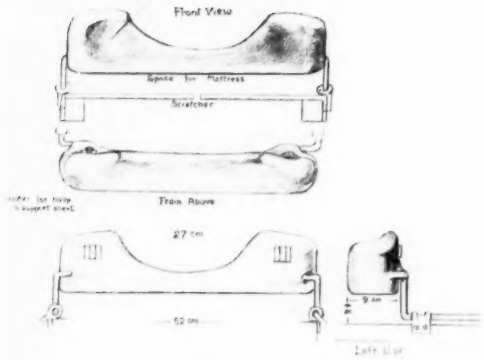

Fig. 5. Carpenter's diagram for construction of yoke. Note that the table attachments are slightly different from those in other figures. This is necessary because of differences in the structure of various tables.

The patient was in deep Trendelenburg position for 1 hour and 24 minutes, her shoulders being supported by two well padded metal braces. At 5:30 that afternoon she complained of numbness and inability to use either arm. The left arm improved rapidly but examination on December 30, 1926, revealed the following: the right arm was paralyzed except for a weak grip and abduction of the arm. She was unable to separate the fingers. Flexion and extension of the forearm were impossible. On the left side all movements were possible but were weaker than normal. Biceps reflexes were not obtained on either side. Sensation was preserved except for some diminution in the region of the thumb and index finger on the left. All the muscles on the left side reacted to electrical stimulation. On the right side, the biceps and triceps did not react to faradic current. The deltoid reacted poorly and the teres minor and infraspinatus were atrophied and did not react. Baking and massage were instituted on December 4, 1926, and continued daily until December 22, 1926. The patient then left the hospital, returning for more treatment on January 29, 1927, and remained until February 11, 1927, and was then discharged wearing an aeroplane splint. On January 27, 1927, there was considerable return of motor power, but she still presented marked weakness of the right arm. The triceps reflex was diminished, the biceps reflex was absent, but pain and tactile sensation were normal. The patient was to return but did not appear. In answer to a letter on December 6, 1927, she wrote: "I am still wearing that support. My arm is not like it was before operation. There is a constant ache in my shoulder, side of my neck, and about half way down my side under the arm. I cannot use it as I can the other hand, but it is a great deal better than it was when I was in the hospital."

CASE 2. Mrs. M. H., aged 25; married; weight, 116 pounds; mother of 2 children; entered the hospital because of a foul brownish discharge. Dilatation and curettage and biopsy from the cervix showed an early medullary squamous cell carcinoma. On January 21, 1927, a radical panhysterectomy was done. She was in deep Trendelenburg position for 1 hour and 2 minutes, her shoulders being supported by well padded metal supports. At 6:00 A.M., the day following operation, she complained of inability to move her right arm. This was associated with pain. On January 26, 1927, she complained chiefly of numbness of the thumb and index finger. Examination showed a flaccid weakness of the right arm and hand. All movements were weak, especially flexion of the biceps. The extensors of the wrist and her grip were weak. There were no definite objective sensory changes. The biceps reflex was lost on the right. On January 27, 1927, physiotherapy in the form of baking and massage was started and was continued until February 12, 1927. The patient was then discharged with an aeroplane splint. She has been seen frequently since then, her last visit being on October 18, 1927, when function had completely returned although she felt her arm was somewhat weaker than its fellow.

CASE 3. Mrs. H. M. J., aged 54 years; married; weight unknown, approximately 150 pounds; mother of one child, entered the hospital on March 8, 1927, with a chief complaint of menorrhagia. Examination showed the fundus to be in second degree retroversion and somewhat enlarged. A diagnostic dilatation and curettage showed an adenocarcinoma of the fundus. On March 15, 1927, a panhysterectomy was performed. She was in deep Trendelenburg position for 1 hour and 13 minutes with her shoulders supported by well padded metal braces. The following morning she complained of an inability to use the right arm. The extensor muscles of the right arm were found to be paralyzed. She at once received baking and massage. On March 30, 1927, all motion had returned with the exception that when the arm was completely flexed she was unable to extend it. She has been seen at frequent intervals since then and the paralysis has cleared so that on August 10, 1927, the function of the right arm seemed normal except that it was slightly weaker than the left.

In reviewing these cases it can be seen that the weight of the individual is of no great importance, as one weighed but 116 pounds. Each patient was in Trendelenburg position for at least one hour and one for 1 hour and 49 minutes, and it is believed that time is of some importance as an etiological factor. Each of these patients received a saline infusion by hypodermoclysis, and this was considered as a possible causative agent but seems hardly likely inasmuch as this procedure is a routine measure in practically all laparotomies in this clinic. The fact that the first patient is still far from recovered emphasizes the seriousness of this condition.

At the time that the first paralysis occurred, a new operating table was being used and it was thought that the metal braces were insufficiently padded and in addition were too narrow. They were at once changed to wider braces and the padding was increased. In spite of these precautions the other two cases developed.

That this condition is avoidable cannot be denied. The fact that the paralyses of this type are usually not serious, has caused them to be belittled by the medical profession, but inasmuch as they may persist for months or even indefinitely all efforts should be used to prevent them. Care should be taken to keep the arms either at

the side or folded upon the chest. There should be no pressure in the popliteal space when the patient is in the Trendelenburg position, and when using deep Trendelenburg, especially as deep as is necessary for gynecologic operations, a suitable shoulder support should be used. By suitable is meant one that will not cause pressure upon one small area but which will evenly distribute the pressure across the shoulders.

It is believed that the Felter yoke fills these requirements very satisfactorily. It was designed by Miss Felter, operating room nurse, in Dr. W. W. Chipman's Clinic at the Royal Victoria Hospital in Montreal, and acknowledgments are made to him for permission to describe the yoke in this article.

The accompanying drawings and photographs are, it is believed, self explanatory (Figs. 1–5). The yoke may be constructed of any kind of wood. The one made for this clinic is of birch, carved to fit the shoulders, heavily upholstered and encased in a rubber covering to prevent soakage from blood and vomitus. It can be made by any carpenter to fit practically any modern operating table. It is attached to the table by two metal uprights, which are angled at 90 degrees and pass through metal cylinders, one of which is permanently riveted to the table upon each side. A set screw is placed in each of these cylinders and by means of these the yoke can be adjusted to fit any length patient. The space for the neck is cut in a gradual curve, and measures 27 centimeters in its greatest width. The yoke is 9 centimeters wide and 9 centimeters high. This yoke has been in use in this clinic since June, 1927, and has proved very satisfactory, and as yet no postoperative pressure paralyses have developed.

CONCLUSIONS

1. Postoperative brachial paralysis is not common, is usually temporary, but may persist for years or indefinitely.

2. It is usually due to pressure and is avoidable by proper position of the arms, proper position of the anæsthetist, and by a well fitting shoulder support when the Trendelenburg position is used.

3. The Felter yoke, causing an even distribution of pressure, seems to be a most advantageous form of shoulder support and being of simple construction can be made by any hospital carpenter.

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VARICOCELE[1]

A Study of Five Hundred Cases

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VARICOCELE is characterized by elongation, dilatation, and tortuosity of the veins of the pampiniform plexus, the spermatic not infrequently sharing this condition with the cremasteric and deferential vessels. Symptoms, if present, are predominantly those of sexual neurasthenia. For this reason, surgical treatment is apt to be resorted to in place of common sense. Varicocele is observed chiefly in young adults and in most of these it disappears symptomatically at least by the time the patient is 35 years old. In private practice, particularly of urologists, patients presenting symptoms sufficiently severe to warrant operation are rare, perhaps one or two a year. On the other hand, in large hospitals we have constantly before us those seeking this operation, a large number of whom do so to fulfill certain physical requirements for national defense organizations (Army, Navy, and Marine Corps) or local municipal departments (Fire, Police, etc.). Of the 500 cases of varicocele here reported from the Urological Service of Bellevue Hospital, one-fourth fall in this category. The large number of these asymptomatic cases subjected to seemingly needless surgery stimulated our study and observations on all phases of varicocele among these 500 cases are here presented.

Two types of varicocele are recognized (a) spontaneous, idiopathic, or primary, and (b) secondary. Secondary varicocele results from spermatic-vein obstruction by intra-abdominal tumors, most often of the kidney, but occasionally large carcinomata of the pelvirectal region, rarely retroperitoneal tertoma or sarcoma. Such varicoceles appear suddenly on either side, grow rapidly to great size, cause little discomfort, and are usually presented by elderly patients bearing a palpable abdominal mass. Pepper (16) cites a case in which the sudden appearance of a varicocele heralded a spindle-cell renal sarcoma 6 months before this tumor was recognized clinically. White (22) saw an acute left varicocele of 6 weeks' duration disappear immediately upon removal of a pyonephrotic left kidney. Especially is the sudden appearance of right-sided varicocele suggestive of abdominal tumor. Varicocele of obstructive origin is readily diagnosed when the patient is placed in the prone position when we note that the veins do not readily empty themselves, as in the primary type. Removal of the obstructing tumor mass constitutes the treatment.

Spontaneous varicocele is the type commonly seen. Usually the etiology is obscure or unknown. Undeniably, age is a factor, for while we had 3 cases, 12 years old, and 1 case 59 years old, over 90 per cent of our patients (Table I) were between the ages of 15 and 35, the period of greatest sexual potentiality. Nearly all were unmarried and had opportunities for sexual relief inadequate to their desires, which serves to perpetuate a constant genital congestion. Abuse by sexual excesses or masturbation may also result in this condition. By analogy, some gynecologists believe that such continuous congestion is a definite factor in the production of varicocele of the ovarian pampiniform plexus (usually left!) which not infrequently is accompanied by symptoms similar to those attributed to varicocele. Although most young adult males are subjected to sexual influences conducive to chronic pelvic congestion but 1 in 10 develops varicocele. Billroth (3) believed this to be dependent on a peculiar diathesis first effecting the vessel of the pampiniform plexus, later those of the leg and rectum. Prima (17) has recently suggested that varicocele is merely one manifestation of a generalized substandard condition. Such hypotheses do not explain unilateral involvement —over 90 per cent are left sided. In this series we found but 2 on the right side alone; 10 were bilateral.

For years this left sided preponderance has been explained on the well known anatomical basis, viz., (a) the left testicle hangs lower than the right; (b) the left spermatic vein is longer, and (c) empties into the left renal vein at right angles and possesses either no valve or at least valves which are inefficient to support the spermatic column of blood. On the right side the vein is slightly shorter, empties directly into the vena cava at an acute angle, and there possesses efficient valves. Anatomical mensuration reveals the left spermatic vein to be normally but 1.5 to 2.5 centimeters longer than the right, hence it seems more reasonable to believe that the physico-anatomical factors, if any, are solely those of efficient valve function on the right side. Vascular dysfunction is more common in old men in whom varicocele is rarely encountered but leg varicosities and hæmor-

[1] From the Urological Service of Bellevue Hospital

Fig. 1.

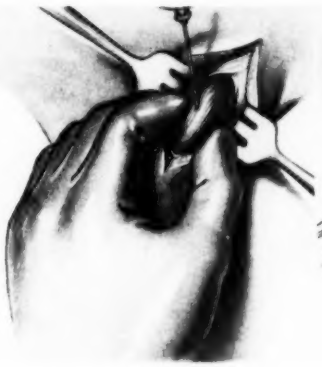

Fig. 2.

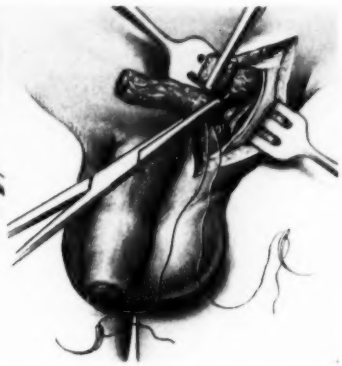

Fig. 3.

Fig. 1. Infiltration and site of the incision for varicocelectomy. The incision is made high in the scrotum and extends somewhat above the level of the external inguinal ring.

Fig. 2. After the funicular sheath with its cremasteric covering has been exposed, the cord, which is still in its bed, is well infiltrated. Injection made high into the lower inguina canal will give a most satisfactory block anæsthesia.

Fig. 3. Excision of the varicocele. Attention is directed to the transfixion ligature on the proximal venous stump. The distal ligature ends are left long so as to be utilized as indicated in Figure 4. The vas with its artery and one or two veins is undisturbed.

rhoids are frequent. Chronic constipation with an overloaded sigmoid obstructing the spermatic vessels, has also been advanced as a cause but this condition also is characteristically a disease of advancing years. Therefore, while the actual cause is unknown, it is certain that chronic passive genital congestion is a most important if not the underlying factor, as is demonstrated by the rapid disappearance of most varicoceles with the assumption of the normal sex relationship of marriage. In other words, marriage symptomatically cures most varicoceles.

PATHOLOGY

Venous tortuosity and dilatation form the pathological picture in the early stages. Later, fatty atrophy, endophlebitis, and not infrequently phlebolith formation ensue. Connective tissue hyperplasia between the distended vessels accompanies the congestion. Moderate varicosities do not involve the testicular blood supply but, with more extensive vascular changes, the testicle circulation may be impaired and atrophy of this organ result (7 times in this series). Testicle changes are those of fatty degeneration followed by atrophic sclerosis. It has been stated that, with dilatation of the veins about the nerves, there is an associated periphlebitis and neuritis accounting for both testicular pain and atrophy. Anatomically, three venous groups are recognized in the spermatic cord: the anterior, having in its midst the spermatic artery, is the first to be affected and constitutes the main body of the varicocele mass; the middle, or those surrounding the vas deferens; and the posterior, passing upward from the tail of the epididymis. Occasionally in old men, varicocele of the posterior group involving particularly the tail of the epididymis results in sclerosis of the lower pole of the testicle. We have not recognized such a case.

SYMPTOMS

Acute varicocele may follow violent strain and is usually accompanied by severe local pains. We have seen it three times.

Otherwise the onset is gradual; many patients bearing varicocele are totally free of symptoms even though the lesion be of considerable size. Too frequently the symptoms are those of sexual neurasthenia, viz., marked depression; nervousness; headache; lack of concentration; impotence; vasomotor disturbances characterized by pallor, cold moist hands, or occasional flushes; and lastly, but perhaps most important, an irrepressible anxiety complex or fear of either a defective genital apparatus or the loss of sexual function. These and a variety of generalized aches and pains out of all proportion to the objective findings are common. Such patients usually display marked modesty on examination and complain of tenderness of the testicle and cord on manipulation.

Of uncomfortable stimuli produced by varicocele, the most frequent is a dragging sensation in

Fig. 4. The proximal venous stump has dropped back into the inguinal canal and disappeared from view. The distal stump is suspended through the external ring beneath the external oblique fascia elevating the testicle somewhat above its mate. The insert shows the anatomical relationship when the suspension ligature is tied. The retracted proximal stump is indicated.

the testicle, often referred to the cord, groin, lower left abdominal quadrant, left lumbar region, epigastrium, or along the shaft of the penis. A low grade aching testicle pain may be constant, sometimes aggravated by standing, walking, or working. Two of our patients (one a skating instructor!) had to give up their customary employment because of extreme pain. In two others the pain was referred to the epigastrium, producing repeated attacks of nausea in one. Curiously, 12 patients alleged their symptoms to be aggravated by warm weather—a vasodilatation being probably the explanation. Scrotal burning after defæcation in one case and burning in the testicle in two instances are characteristically the symptoms of neurotics. One hundred twenty-eight sought operation to fulfill certain physical requirements for civil service, army, etc., practically all of whom were asymptomatic, many ignorant of the lesion until appraised of its presence by the examining officer.

TABLE I.—AGE OF PATIENTS

Age	Cases
19 years and under	69
(12 years...3)	
20 to 24 years	215
25 to 29 years	111
30 to 39 years	71
40 to 49 years	18
50 and over	5
Not stated	11

TABLE II.—DURATION OF VARICOCELE (AS NOTED BY PATIENT)

Age	Cases
Under 3 months	39
3 to 6 months	21
6 to 12 months	46
1 to 2 years	66
2 to 3 years	35
3 to 5 years	70
5 to 10 years	70
10 to 15 years	6
Over 15 years	12
"Life"	8
"Many years"	18
Not stated	119

Objectively, one notes a relaxed scrotum, a low hanging left testicle with the outline of the tortuous veins often visible against the scrotal wall. Palpation discloses the typical "bag of worms" feeling which can be confused with no other lesion except rarely omental hernia. At times small phleboliths are encountered. The testicle occasionally shows atrophy, noted by some with incidence as high as 11 per cent (17); in our series a trifle over 1 per cent (Table II). Scrotal varices are also found, sometimes focusing attention to the accompanying varicocele by their presence or by rupturing, as in one case of ours. Varices of the wall may also induce annoying scrotal itching. A thickened epididymis is a common finding and whether it is associated with the chronic congestion or results from infection is not known.

DIAGNOSIS

Omental hernia is perhaps the only condition apt to be confused with varicocele, and we may rule this out by having the patient lie down and noting the emptying of the scrotal veins. A finger is placed over the external inguinal ring, and when the patient rises, the omental hernia will be held back while the veins again fill. Many varicoceles are associated with inguinal hernia (40 times in this series), but the presence of the latter should not make diagnosis difficult. Hydrocele of considerable size may obscure the varicocele.

Most men lose their varicoceles after marriage. Rarely does the lesion persist although sometimes progressive enlargement continues, terminating perhaps in atrophy of the testicle.

TREATMENT

Greatest interest and importance attaches to treatment. Unquestionably too many varicocelectomies are performed. Timely warning in this direction was sounded by Bloodgood (4), soon after this country entered the war, particularly as applied to wholesale operating on recruits. He cautioned that the majority of varicoceles dis-

appear after a period of years and that most of the men complaining of varicoceles are neurotics and are not relieved by operation.

We recently confirmed Bloodgood's observations in a study of a group of 150 men under 30 years of age and another group of 150 over 50 years of age. We found that of the first group, 9 had moderate sized varicoceles, in 4 of whom the lesion produced symptoms. Of the group over 50 years, 4 had anatomical varicocele, none complained of symptoms, and 6 gave a history of having suffered with varicocele in early life but stated that the condition had since disappeared. None of these 6 had been operated upon.

Bloodgood and later Douglas (8) pointed out the severe complications which may result from varicocelectomy—hæmorrhage; infection; epididymitis; hydrocele; and, most particularly, loss of a functioning testicle by atrophy—all presumably to no benefit. In a careful follow-up in 106 of 303 cases operated on for Army enlistment, Douglas found but 48 per cent normal after a postoperative intermission of many months, 39 per cent had hydrocele, and 4 had atrophy. With this cheerless anticipation, one considers surgical treatment.

Therapeutically as well as clinically, three types of varicocele are recognized. The first type, asymptomatic varicocele, whether large or small, is best left alone since operation frequently induces numerous subjective symptoms leading ultimately to a definite neurosis. Most of these patients are unaware of the lesion until it is demonstrated by an examining physician. Most of the 128 cases operated on at Bellevue for enlistment or civil service fell in this class; these patients are operated on against one's better judgment. The second type denotes its presence by scrotal enlargement and a feeling of weight or a dragging sensation either in the scrotum (testicle) or referred to the cord, groin, loin, etc. These cases are uniformly benefited by operation and constitute the type in which operation is definitely indicated. The majority of varicoceles fall in the third group—those which are small, yet which may be the determining cause of a sex psychosis progressively undermining both mental and physical stamina. These patients are a serious problem; their symptoms and reactions are characteristically alike. Anxiety regarding the integrity of their sex apparatus is their first concern. Not infrequently they plead for an operation, but in the same breath refuse to give their consent for fear of surgical injury to the testicle. They are entitled to not a little patience on our part and an explanation of the origin and mechanism of varicocele with the assurance that the condition is not a serious one and that after marriage it will probably disappear. Patients who are refused or who refuse operation, easily fall prey to the charlatan or unscrupulous practitioner who encourages the patient's notion that varicocele will cause "lost manhood."

TABLE III.—ASSOCIATED SURGICAL CONDITIONS

Condition	Cases
Hernia	
Right	5
Left	40
Bilateral	14
Scrotal varices	5
Hydrocele	
Left	4
Right	1
Stricture urethra	1
Spermatocele left	1
Movable right testicle	1
Circumcision	23

At Bellevue Hospital, we operate, perforce, on many of these varicocele neurotics. They will not help themselves and, if not operated upon, allow themselves to progress to an ill-fate.

We do not operate on asymptomatic patients, however, unless they have been sent in by surgeons of the various municipal departments; particularly the fire and police departments. A short time ago we addressed a letter of inquiry to the chief surgeons of these departments to ascertain the rationale of operation in these asymptomatic cases. No reply has been received to date. To a similar inquiry, Surgeon-General E. R. Stitt, U. S. N., answered: "It has been our experience in the Navy that it is not the large varicoceles that cause symptoms but rather the small ones, and they are usually associated with neurasthenia or hypochondria. Such patients repeatedly apply for treatment until the condition constitutes a disability for efficient service. * * * It has been my custom as Surgeon-General, when candidates for the Academy have been rejected because of varicocele causing symptoms, to advise against operation and in most cases this defect is waived unless it is associated with certain other disqualifying defects. It is, of course, realized in the case of enlisted men that it may be a convenient excuse for malingering." Lieutenant-Colonel J. F. Siler of the Surgeon-General's Office, War Department, replied: "Varicocele is not a bar to enlistment or commission unless it be large or painful." An enclosed tabulation indicated that in the Army 8,736 days of hospitalization were caused by varicocele from 1922 to 1926, inclusive, further evidence that the condition merits serious consideration.

Operation is indicated then, in cases of large varicocele causing symptoms—particularly those

TABLE IV.—SYMPTOMS (SUBJECTIVE)

	Cases
Varicocele	57
Swelling	80
Dragging	98
Pain	
Constant	98
(stopped work 2)	
On exertion	18
On standing	12
Intermittent	2
Along penis	1
Referred to	
Groin	12
Lumbar region	6
Epigastrium	2
(with nausea 1)	
Lower lt. quadrant	3
Burning sensation in testicle	2
Scrotal burning after defæcation	1
Scrotal itching	4
Ruptured scrotal varices	1
Civil service	128
Symptoms increased by warm weather	12

of weight or drag—in which atrophy of the testicle is feared. Operation is indicated in the third group—the small varicocele with symptoms out of all proportion to the objective findings—only if correction of sexual hygiene is hopeless, psychotherapy has failed, or the wearing of a suitable scrotal suspensory has given no relief. In the German Army (23), operation is performed only when a suspensory fails to relieve. Sanford (19) cites as other indications for operation: absence or disease of the opposite testicle, complicating hernia, or hydrocele of the same side, a history of recurring phlebitis, thrombosis, spontaneous rupture, or calcareous condition of the veins.

OPERATION

In most cases, local anæsthesia is the anæsthetic of choice. An excessively neurotic patient may demand general anæsthesia, as occurred 6 times in our series. In some of our earlier cases complicated by herniotomy, general anæsthesia was given, but we now do these under regional block.

While I have had no experience with the procedure, others have found that resection of the scrotum for varicocele neither cures nor relieves since the remaining sac containing the heavy venous mass soon attains its former size.

Subcutaneous ligation devised by the elder Keyes (14) relieves varicocele, detains the patient in bed but a day or so, but does not relieve pain. Moreover, it is a blind procedure, not without danger of trauma and hæmorrhage and at present is rarely employed.

For novelties in varicocele operations, one must look to the European surgeons. The underlying

TABLE V.—PHYSICAL EXAMINATION

Condition	Cases
Testicle	
Atrophy	
Slight	3
Moderate	3
Marked	1
Enlarged	7
Tender	5
Epididymis	
Indurated	20

principle in most of these procedures is ample suspension of the testicle thus relieving the vas of the weight—the cause of most of the pain, more particularly cord pain. This suspension is brought about by various methods as, for instance, transverse suture of a longitudinal incision of the cremasteric fascia (19); or deviation of the course of the spermatic cord by (a) (14) creating a new and higher internal inguinal ring, or (b) suspending the cord through a fascial flap in the external oblique,—all without excision of spermatic vessels (21). Fiorini combined excision of the spermatic veins with eversion of the tunica vaginalis and suspension of the testicle to the pillars of the external ring. Amorosi (1) and Jacob (13) also described orchidopexy, the operation of the latter differing in minor details from that devised by Vincent at about the same time (1918) on the Urological Service at Bellevue Hospital. This remains to the present our standard procedure for varicocelectomy. Vincent's operation is recorded only by Keyes (14). The following is a description of the method.

After novocain infiltration (Fig. 1), a low hernia incision exposes the external ring and the emerging spermatic cord. Further cord infiltration is usually advisable at this point (Fig. 2). The vessels are exposed by a longitudinal incision through the cremaster and the funicular sheath. The anterior vessels are separated from the deferential group as high as the external ring and down to a point, which, when raised to the level of the external ring, will elevate the testicle about 2 centimeters higher than it normally hangs. These mobilized anterior veins—constituting the main body of the varicocele—are divided between clamps (Fig. 3) and each is tied securely with a transfixion ligature at least 1 centimeter from the cut end so that the ligature will not slip off. The ligature of the proximal stump is cut short and this part is dropped back into the inguinal canal where it retracts from sight. On the other hand, the ligature on the distal stump is left at least 6 inches long. The intercolumnar fascia is now divided and with a knife handle or grooved director a path is burrowed underneath the external

oblique to a point opposite the internal inguinal ring. The long ends of the ligature, each threaded on a blunt or aneurism needle, are introduced into the inguinal canal under guidance of the director or knife handle and at a point opposite the internal ring are separately pushed through the aponeurosis of the external oblique. They are then tied over the few intervening strands of aponeurosis (Fig. 4). The tying of this ligature pulls the distal stump up into the inguinal canal thus elevating the testicle about 3 centimeters higher than its usual level and relieving the vas of all tension. The wound is closed without drainage.

We then apply the Bellevue scrotal suspensory (5, 6). This dressing affords both testicle splinting and suspension until the upper portion of the elevated venous stump becomes partially fibrosed to its new inguinal position. Unless this support is applied, there is likely to be slipping of the suspended organ even though chromic suspension sutures are employed. This method was followed 398 times in this series. In the remainder, the generally used end-to-end tying of stump ligatures after venous excision was performed. Five days in bed, postoperatively, usually suffices; the average period of hospitalization in uncomplicated cases was 6.4 days.

We are careful, in performing varicocelectomy, to keep away from the tunica vaginalis unless it is to be opened for hydrocele, as trauma will increase the probability of subsequent hydrocele. In elevating the testicle, if one carelessly pulls too hard, the tunica vaginalis will not infrequently be found presenting in the wound, an excellent position for traumatization.

COMPLICATIONS

Hydrocele is the most common complication of varicocelectomy and as already indicated, follows injury to the tunica vaginalis. The specific gravity of such hydrocele fluid proves that it is not a transudate resulting from vascular disturbances as alleged by some. Transudates are characterized by a low specific gravity 1.002 to 1.006; hydrocele fluid registers 1.020 to 1.026 or that of an inflammatory exudate—in these cases of traumatic origin. Hydrocele as a sequela of operation for varicocele was found in 39 per cent by Douglas (8), 30 per cent by Bloodgood (4), and 23 per cent by Corner (7). We have been able to follow personally but 42 patients in this series. Of these, 4 developed hydrocele; 2 were moderate sized (estimated at 5 ounces), the others were small (15 cubic centimeters). Perhaps our small number of hydroceles following varicocele operations is explained by the care employed to operate in the inguinal region and to avoid trauma of the tunica vaginalis.

TABLE VI.—SURGICAL TREATMENT

	Cases
Anæsthesia	
General	21
Local	479
Type of operation	
End-to-end	102
Suspension and excision	398
Scrotal resection	2
Additional operations	
Hydrocele	5
Hernia	46
Spermatocele	1
Complications	
Infection	
Superficial	55
Deep	34
Hæmatoma	7
Epididymitis	
Acute	1
Subacute	4
Cut vas	1
Venous thrombosis	1
Slipped ligature with severe retroperitoneal hæmorrhage	1

Atrophy of the testicle is, with one exception, the most serious complication. In the 42 cases followed, 1, a medical student, showed marked atrophy; 2 showed moderate atrophy. Bloodgood in studying herniotomy with resection of the veins found atrophy in 15 per cent of 61 cases; without resection, in 1 case in 109. Corner found the testicle smaller after operation in 21 per cent.

Hæmorrhage may be the most serious complication, as in one of our cases. A boy, 20 years old, complaining of scrotal enlargement and testicular pain for 10 years, was operated on by a member of the house staff who performed the routine varicocelectomy with suspension of the testicle. Fifteen minutes after returning to bed, the patient found his scrotal dressing soaked with blood. He was returned immediately to the operating room and given a general anæsthetic. The wound was reopened, and it was seen that the bleeding came through the external ring, but the source was not disclosed until the lateral abdominal wall was widely opened and the peritoneum pushed back. This revealed the freely bleeding and greatly retracted proximal venous stump from which the ligature had slipped. After a ligature had been properly applied and a large amount of blood had been evacuated, the wound was closed with drainage. The patient promptly developed a deep infection which for some time was most threatening but eventually healing was completed. Free and speedy retroperitoneal exposure is required in such cases. Fagge (9) reports a similar instance in which slower bleeding produced a flank mass with

TABLE VII.—FOLLOW-UP CLINIC

	Cases
Hydrocele	4
Atrophy	2
Good result	36
Recurrence	0
Occasional pain	3

fever. It was diagnosed as a hypernephroma but exploration enabled evacuation of over 60 ounces of retroperitoneal blood clot with ultimate healing. Localized hæmatomata from wound bleeding are usually not alarming although we saw one which extended suprapubically for 3 inches, down along the penis, enlarging this organ to thrice its normal size, and into the scrotum where its size demanded evacuation. Scrotal resection for superficial varices in addition to varicocelectomy with suspension in two cases was followed by scrotal hæmatoma, one case requiring evacuation of the clots. Scrotal resection is rarely, if ever, indicated.

Infection often follows bleeding. Deep infection usually associated with hæmatoma followed operation in 34 of our cases. One wisely avoids handling the skin in performing varicocelectomy as it is practically impossible to sterilize the skin of the scrotum and lower groin.

Postoperative induration is frequently noted but nice attention to hæmostasis will obviate most of this. Skillern (20) devised an operation said to eliminate induration—a complete resection of the anterior veins from the internal inguinal ring to the testicle without disturbing the vas in its bed.

Acute epididymitis followed operation in 3 days in 1 case; subacute epididymitis developed in 4 others. Once the unidentified vas was accidentally cut but it was immediately sutured. Venous thrombosis was noted once. In a case of Keyes (15), several surgeons failed to make the diagnosis of pampiniform plexus thrombosis because, never having felt such a thing before, they were unwilling to permit their fingers to make the diagnosis. Removal of the clotted veins was followed by good result.

Testicular pain was complained of by 3 of the 42 follow-up cases. In one, a suspensory brought relief; in another the discomfort was noted in hot weather only. Of patients followed by Barney (2), 36 per cent still had pain, 27 per cent had a sex neurosis, and 15 per cent suffered a recurrence. In our series, re-operation was performed in 9 cases originally operated on elsewhere. We are not aware of recurrence but if we were able to follow more of our patients, probably many more complications and undesirable sequelæ could be recorded. However, this operative procedure as used at Bellevue has proved far superior to other methods more commonly employed, and because it does uniformly relieve testicular pain and drag, which are the chief symptoms of varicocele, we believe it to be the technique of choice.

SUMMARY

The etiology of varicocele is not clear but in most cases varicocele is associated with chronic genital congestion induced by faulty sexual hygiene. Of the 500 cases here reported, 9 of every 10 were between 15 and 35 years of age. Advancing years or marriage symptomatically cure most varicoceles. The right side is but rarely involved. If the lesion is large and of long standing, testicular atrophy is frequently observed. The "bag of worms" feeling elicited on palpation of the pampiniform plexus establishes the diagnosis. Clinically and therapeutically, three types of varicocele are recognized: (1) asymptomatic varicocele, of which the patient is unaware. These are best left alone. (2) Moderate or large sized varicocele. Its presence is denoted anatomically by scrotal enlargement and symptomatically by a feeling of weight, pain, or a dragging sensation either in the testicle or referred to the cord, groin, or loin. Operation benefits these cases. (3) Small varicocele which causes symptoms disproportionate to the objective findings. Most varicoceles are of this third type. The patients are broadly grouped as sexual neurasthenics. They are best treated by the institution of common sense sexual and physical hygiene. A scrotal suspensory will relieve many. In this type of patient, operation is usually unsatisfactory as the symptoms persist after operation.

The suspension operation devised by Vincent on the Urological Service at Bellevue Hospital is the procedure of choice because it uniformly relieves pain and testicle drag and postoperative sequelæ are minimal. Hydrocele and atrophy of the testicle are the most frequent postoperative complications. Hæmorrhage from the spermatic vessels may be most serious. It should be remembered that the tunica vaginalis may be injured without presenting itself in the operative field and care to operate high on the cord with a minimum of manipulation will do much to diminish the incidence of postvaricocelectomy hydrocele. Atrophy follows operation in a moderate number of cases. Employment of transfixion suture about the resected spermatic cord vessels will eliminate severe hæmorrhage. After operation, testicular support is very essential for at least 10 days. The patient is usually confined to bed only for from 5 to 7 days.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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OCTOBER, 1928

THE CANCER CELL IN GENERAL PRACTICE

THE most outstanding conclusion at the last International Conference for the Control of Cancer was that cancer must be recognized in its earliest stages if it is to be cured by present methods. The chief function of the American Society for the Control of Cancer and an important activity of the American College of Surgeons is the education of the public and the profession in the early recognition of cancer.

The gradual average reduction each year in the size of neoplasms as they are seen in some of the larger clinics proves that popular and professional cancer campaigns are yielding the desired results. Coincidental with such reduction in size has come the increasing difficulty of differential diagnosis. Statistics show that clinicians are making a smaller percentage of positive clinical diagnoses of malignancy. These two facts, the reduction in the size of neoplasms and the increasing difficulty of diagnosis, demand professional attention and will probably be met by exploration and biopsy, examination of tissue by excision, if not incision of the tumor, for clinical diagnostic purposes. This procedure will not be useful unless pathologists recognize the value and the proper method of making fresh tissue examinations. Tissues must be fresh and unfixed; they may be frozen and sectioned with a microtome or sectioned with a razor, the latter giving thicker and not as satisfactory preparations. Frozen sections should be stained with Unna's or Terry's polychrome methylene blue by immersion in the stain. Razor sections should be painted only on one side. Sections made by the latter method rapidly fade but are satisfactory if a microtome is not available. The technical method, however, is not the important part of making a diagnosis; it is merely a means of saving time. Knowledge of details of the morphology of normal, regenerative, and neoplastic cells as seen with an oil immersion lens, and wide experience in checking pathological against clinical data are the essential qualifications of a properly trained expert diagnostician of tissue. Fixed and embedded tissues will not serve in the cytological study of fresh tissue. Malignant cells have definite morphological and volumetric characteristics which distinguish them from adult and regenerating cells. These characteristics can be seen only in the fresh unfixed condition with an oil lens. The old histological criterion, the penetration of the basement membrane, does not represent the earliest stage of malignancy although it might be the arbitrary criterion for naming a lesion cancer; malignant cells actually exist before the invasion of tissues and although they may not be called cancerous they are indistinguishable morphologically from cells which all pathologists call cancerous. These

cells are seen in the tubules and frequently outside the tubules in the breast, in borders of chronic gastric ulcers, and in the uterus. In the absence of any specific serological test or skin reaction for cancer, the presence of these cells is the best means of making early diagnosis. Their presence as an index for radical or extensive removal of an organ or the tissue containing them is more conservative and more definite than the past clinical criterion.

If, therefore, patients are to be urged to take early heed of all lesions and to submit to exploration and biopsy, we must be prepared to recognize these early changes in cytology. Pathologists must become familiar with fresh tissues and be prepared to render immediate service to surgeons so that the patient may have the benefit during the operation of early biopsy reports. It is only in this manner that the medical profession can properly react to the public's response to cancer propaganda centered around early diagnosis.

WILLIAM CARPENTER MACCARTY.

A CLINICAL APPRAISAL OF CHOLECYSTOGRAPHY

CHOLECYSTOGRAPHY represents a distinct contribution to medicine for which the profession is greatly indebted to Graham and his co-workers. It is undoubtedly the best existing single laboratory test and promises to be as extensively utilized in the diagnosis of cholecystic disease as roentgenoscopy in diseases of the upper digestive tract. The method, moreover, has been an indispensable procedure in present-day research directed to the function of the gall bladder, particularly to the mechanism of its emptying, concerning which there has been much disagreement. Both clinician and surgeon have welcomed its advent as they appreciate the superiority of visualizing methods of diagnosis. However, there are certain definite limitations to the method of which both physician and surgeon should be cognizant. Previous reports, without exception, have been misleading in that diagnostic efficiency has been estimated largely on the basis of a group of cases in which the gall bladder was removed because of a diagnosis of cholecystic disease from the cholecystogram. Diagnostic accuracy as high as 98 per cent has been claimed. The actual diagnostic value of the method can be determined only by a consideration of its limitations and possibilities for error at the same time. Before discussing these limitations, it seems reasonable to assume that further progress is possible in this field only after the adoption of a common standard of what constitutes adequate gross and microscopic evidence of cholecystic disease. It also seems reasonable to maintain that meticulous examination of a gall bladder may disclose departures from the normal, resulting at times from a former transient and resolved inflammatory process which may have left the viscus able to function normally and not give rise to untoward symptoms. Pathological criteria can be made so conveniently elastic that any slight departure from the normal could be made the excuse for removing the gall bladder when the operation was undertaken on the basis of a mistaken cholecystographic diagnosis.

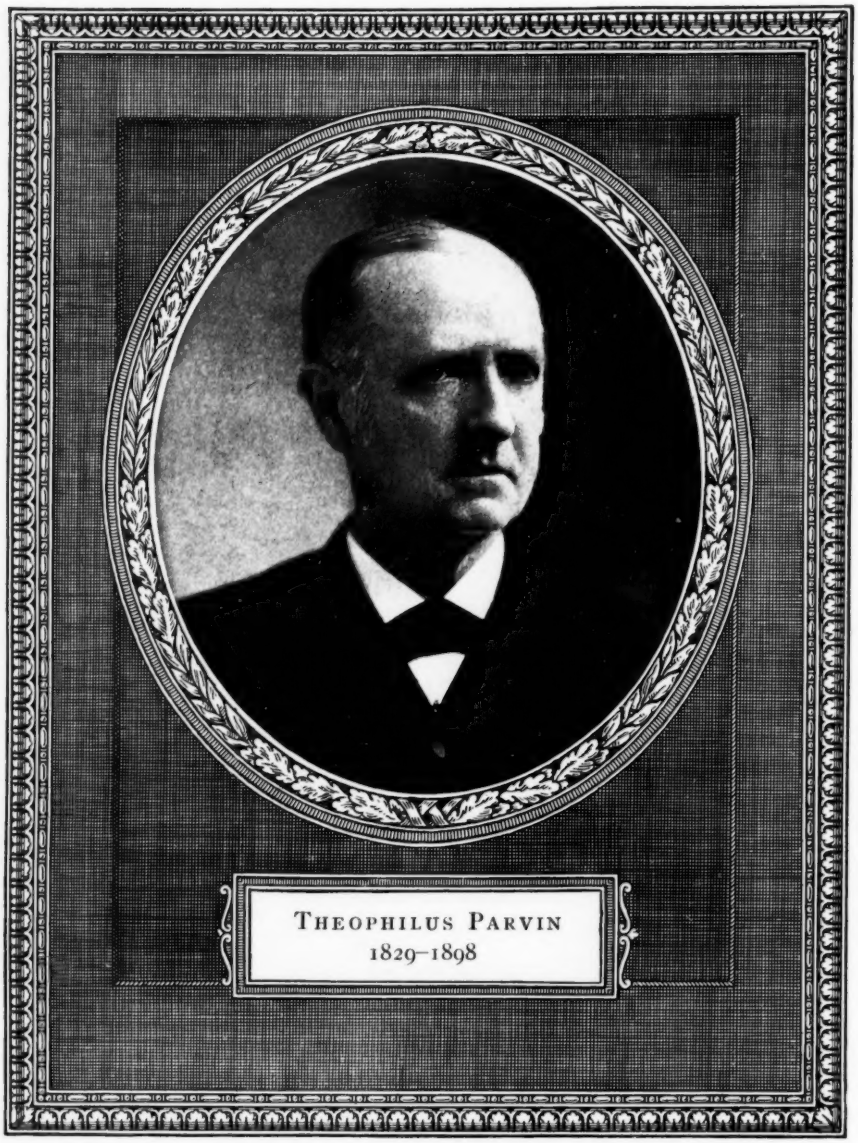
Certain facts become readily apparent to those who have had wide experience with cholecystography. First, cases that afforded definite clinical evidence of cholecystic disease, chiefly of calculous cholecystitis, hydrops, empyema, acute, subacute, and gangrenous cholecystitis, and obstruction of the cystic duct, also invariably afforded positive evidence of disease in the cholecystogram.

Second, the clinical history and physical examination, after exclusion of the stomach and duodenum as the site of disease, in many instances enabled the clinician to make a diagnosis of definite cholecystic disease, verified at operation in a little more than 90 per cent. In this group cholecystographic examination would have been superfluous except for scientific reasons. Finally, the high degree of cholecystographic accuracy, in cases verified surgically, was probably more apparent than real. Such cases were really sifted out by the clinician. In other words, with the exception of a small group of clinically indefinite cases, or those in which symptoms were mild, with evidence of calculi in the cholecystogram, clinical criteria rather than cholecystography furnished the basis for diagnosis and operation.

The limitations of the method are brought about by various factors such as variation in the response to the test in normal and pathological cases on repeated examination, various sources of error both in technique and interpretation, and frequent positive cholecystographic evidence of disease in which there is absence or insufficient clinical evidence of it. Positive errors are especially seen in two clinical types of cases: the asthenic, visceroptotic, nervous patient with gastric subacidity or anacidity, often associated with a lowered basal metabolic rate, and the patient with hyperacidity, from whatever cause, and especially one with duodenal ulcer. On the basis of a large series, 41 per cent of the proved positive errors occurred in patients with duodenal ulcer, in whom the gall bladder was found objectively normal at operation. What is more important, there is a considerable number of cases in which cholecystographic data are negative and in which definite symptoms and signs of cholecystic disease are verified at operation; in fact, "false negatives" range as high as 25 to 30 per cent. This important feature has not been sufficiently stressed in the literature. The silhouette of the thickened, diseased gall bladder itself may simulate the appearance of the dye-filled viscus, thus misleading the inexperienced clinician and surgeon. In a sense this is a negative error. A false negative response is highly possible in a gall bladder containing pure cholesterin, or cholesterin rich stones, which are often found in normal appearing thin-walled gall bladders, therefore causing little change in the concentrating activity of the organ. Such stones comprise almost 20 per cent of the total, and negative responses are often seen although the history may be typical of hepatic colic.

It is reasonable to infer that the intravenous mode of administration of the dye is the more reliable. Whether it is sufficiently superior to replace the oral method, which is far more convenient to administer and less uncomfortable to the patient, has not as yet been determined. Both methods have their enthusiastic proponents. Undoubtedly under certain circumstances, especially in cases with anacidity and hyperacidity, a repetition of the test by the intravenous method in doubtful cases is indicated. Ordinarily a repetition of the oral method should suffice. Champions of the intravenous method should remember, however, that the negative cholecystographic response is the least reliable of all signs and the silhouette is intensified by this method.

Cholecystography is essentially a test of function and not of disease, a fact recently conceded by Graham. The identification of the stones as shown by negative shadows is the chief exception. At the present stage of development, cholecystography should not be relied on to the exclusion of other data to affirm or reject the presence of a diseased gall bladder. GEORGE B. EUSTERMAN.



THEOPHILUS PARVIN
1829–1898

UNIV OF MICH.

MASTER SURGEONS OF AMERICA

THEOPHILUS PARVIN

THEOPHILUS PARVIN, probably the most classical, philosophical contributor to the literature of obstetrics and gynecology America has ever known, was born in March, 1829, at Buenos Aires, Argentina, where his father, the Rev. Theophilus Parvin, was stationed as a missionary. His mother was the daughter of Cæsar Augustus Rodney, attorney general of the United States under President Jefferson. She died when he was two weeks old and his father brought the child back to this country. The father died, however, when young Theophilus was 7.

Parvin entered LaFayette College at 12, and finished his academy career in the University of Indiana in 1847. He studied Greek and Hebrew at Princeton, received his master's degree in 1850 at the age of 21, and the degree of doctor of medicine from the University of Pennsylvania in 1852. For 2 years he shipped as surgeon on a line of packets between Philadelphia and Liverpool. He filled successively the chairs of materia medica at Ohio Medical College 1854 to 1864: of obstetrics and diseases of women in the University of Louisville where he remained until 1869; of obstetrics and diseases of women at Jefferson Medical College, Philadelphia, from 1883 until his death in 1898. Dr. Parvin showed his versatility in accepting the post of house surgeon of Wills Eye and Ear Hospital in Philadelphia, immediately upon his graduation.

His writings attracted attention, and he was besieged with offers of editorship of medical journals. In conjunction with Roberts Bartholow, who was with him on the faculty of Ohio Medical College at Cincinnati, Parvin edited the *Cincinnati Journal of Medicine* which is now in charge of Dr. Charles L. Bonifield. In 1866–7 and in 1868–9 he edited the *Western Journal of Medicine;* with David Yandell, of the University of Louisville, he was co-editor of the *American Practitioner* 1869–1883.

In going through the bibliography of the latter third of the 19th century, one is struck with the myriad of his contributions and the great variety of subjects upon which Parvin wrote, always with a style most entertaining and illuminating. His textbook, *The Science and Art of Obstetrics*, which ran rapidly through several editions, was marked by its accuracy and erudition and as well by the abundance of classical and modern references with which it abounded.

He translated von Winckel's *Diseases of Women*, from the German; was a contributor to Ashhurst's *Encyclopædia of Surgery;* Sajous' *Universal Medical Sciences;* the *American Textbook of Obstetrics* and the *American Textbook of Therapeutics*.

He was successively elected president of the State Medical Society of Indiana, the American Medical Association, and the American Academy of Medicine; he was one of the founders and an early president of the American Medical Editors Association and he was a founder and president of the American Gynecological Society, the Philadelphia Obstetrical Society, and various other medical organizations.

In 1892 he presided at the International Congress of Obstetrics in Brussels. In 1890, I first met him while he was chairman of the obstetrical section of the tenth International Medical Congress at Berlin, where he was associated with Koch, Esmarch, Playfair and Pasteur, on a most notable series of programs. A long list of honorary fellowships in foreign societies is attached to his name. The preserved contributions to the then current medical literature comprises over one hundred and fifty titles, but these do not include all his writings. He must be classed as one of the great men who have illumined the medical profession with their intellectual attainments. His vigorous well chosen English was a delight. His classical allusions were always apt. In fact he was the embodiment of the erudition which pervaded all his writings through the thirty years (1868–1898) of his active professional and teaching career.

Dr. William H. Parrish who wrote his obituary for the American Medical Association said: "Theophilus Parvin's career as the master obstetrician of America is familiar to the medical profession. During the last quarter of the 19th century he ranked undoubtedly among the greatest living authorities in medicine."

His textbook on obstetrics was received enthusiastically by students and physicians alike, and occupied the relative position in obstetrics that Samuel D. Gross' monumental work did in surgery; that Sir Thomas Watson and Trousseau did in medicine, and Roberts Bartholow's *Materia Medica* did in therapeutics.

In 1889, Dr. Parvin established the first obstetrical clinic in America; following the method of von Winckel in Munich, 34 cases were delivered without a maternal death. In making a report of this enterprise before the New York Academy of Medicine, Parvin appealed to that organization to set the light to guide the profession, making clinical obstetrics a part of the curriculum of the medical school of the country. He urged that every college which refused to take this step should be criticized by common condign condemnation.

Three philosophical essays of Parvin have come down to us, in which a third of a century ago he analyzed problems which are today of peculiar interest.

These were on "The Genius of Medicine," "The Woman and her Physician," and "The Casuistry of Medicine." The first was based on Conte's definition of a science as "Knowledge which enables us to foresee and foretell events." He said in substance: "Let any case of common disease be examined by half a dozen educated physicians, and there would be in almost every instance an exact agreement as to the nature of malady, its progress, and the means advisable to eliminate it, or to shorten its course. The natural history of disease is so like an open book to the trained physician that he can in the majority of cases foresee and foretell it."

Parvin said that the student must not forget that the foundations of our science were laid by Hippocrates, the noble Greek, and that it came not from the temple nor the gymnasium but from the laboratory of the physician.

In his oration on "Woman," Parvin says: "Beauty is the common physical characteristic of woman; age, disease, poverty, suffering, ignorance, the play of evil passions may mar or destroy the beauty, not in a single individual only, but in those deriving their origin from her. Nevertheless this gracious gift is the general possession of the sex."

To show the remarkable impression Dr. Parvin made on his auditors, by the flight of his poetic tribute to the power of the beauty in woman, I will quote the following incident. I was astonished while speaking of his life before the Louisville Obstetrical Society, in February, 1927, to hear Dr. William B. Doherty, now 85 years of age, who was on the Faculty as an instructor when Parvin taught in the University of Louisville, repeat from memory the quotation from the twenty-fourth ode of Anacreon, the Greek poet, wherein he spoke of the gifts of nature to all that breathe the air of heaven some boon; wreathed horns to the bull; the hoof of strength to the steed, speed to the timid hare. Then this apostrophe to woman.

"To man she gave in that proud hour
The boon of intellectual power.
Then what O woman! what for thee
Was left in Nature's Treasury?
She gave thee beauty—mightier far
Than all the pomp and power of war.
Nor steel nor fire itself hath power,
Like woman in her conquering hour
So be but fair, mankind adores thee,
Smile, and a world is weak before thee!"

The motive of Parvin in this address on woman was to emphasize the peculiar type of relation between the sexes and the delicacy needed in the practice of gynecology and obstetrics as contrasted with other departments of medicine.

His greatest effort was in the essay "The Casuistry of Medicine" in which he showed the problem which dominated all philosophy, all science, and its applica-

tion to art not only in the ordinary relations of life but to us specifically through the evolution in medicine from that of Æsculapius and Hippocrates down to our own myriad of specialties—the problem of right and wrong in a debatable decision. Of course, Parvin used the definition of casuistry as in its original application by the Jesuits in solving the questions of conscience; the interpretation of ethical principles to questions of conscience and judgment. He discussed many questions which today are still matters of controversy, birth control, the induction of abortion where he quotes: "Lex, lex dura sed lex"; the right of the mother against the child if either is to be sacrificed; the question of which phase of prevarication constitutes lying in medicine which President Fairchild of Oberlin College decided in his day and Joseph Collins in ours has elucidated. Many other points will appeal to every surgeon interested in medical history because, as Parvin said, casuistry is just as much to be applied to reasoning, judgment, and philosophy today as it was in the beginning of history.

Dr. Parvin is survived by a son Dr. Noble Parvin and a daughter Mrs. James P. Baker, both living in Indianapolis. To them as well as to the successors in the chairs he graced in the various medical schools, I am indebted for much of the personal data of this tribute to one of my ideals—Theophilus Parvin.

GEORGE CLARK MOSHER.

LA GRANDE

CHIRVRGIE DE M. GVI DE CHAVLIAC, MEDECIN TRES-FAMEVX DE l'Vniuerſite de Mompelier, compoſee l'an de grace M. CCC. LXIII.

RESTITVEE NOVVELLEMENT A SA DIGNITE,

Par M. LAVRENS IOVBERT, *Medecin ordinaire du Roy, & du Roy de Nauarre, premier Docteur regent ſipendié, Chancellier & Iuge de ladicte Vniuerſité.*

Voyez au prochain feuillet, ce que M. IOVBERT ha faict (outre ſa nouuelle traduction) & fourny du ſien, en recognoiſſant ceſt' œuure.

A LYON.
PAR ESTIENNE MICHEL.
M. D. LXXIX.
Auec priuilege du Roy.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S., Omaha

THE GREAT SURGERY OF GUY DE CHAULIAC

GUY DE CHAULIAC came into a world which was actively undergoing a period of reconstruction in all its intellectual and economic phases. The crusades were only thirty years past at the supposed time of his birth (1300), and the lessons which they taught were being absorbed and were causing a readjustment in the mental concept of the relation of the individual to life and its responsibilities. The dark pall cast by blind faith in the dictates of medieval mystical monasticism was being rent asunder and the light of reason and learning gained from the pagan Saracen was peeping through to give the European a sight of the advantages of study and education on the one hand and of international trade through amicable commercial relations on the other. This change had been going on gradually during the centuries of the crusades but it was not until the actual fighting ceased that the change in the psychological reactions of the people was fully appreciated. Nevertheless the armamentarium so to speak, which future generations were to use to their great advantage, had been prepared. The Universities at Salerno, Padua, Bologna, Paris, Montpellier, and Oxford had been founded and the learning of the Ancient Greeks and the Arabian School was there to be taken advantage of by him who wished. In addition to these general world conditions, Guy de Chauliac had the opportunity of carrying on the work of two great surgeons of his own country, Jean Pitard (died circa 1328) who had founded the Collège de St. Côme, and Henri de Mondeville (died circa 1320) who had been the famous professor of surgery at Montpellier.

Guy de Chauliac was born in the little hamlet of Chauliac about 1300. He received his first instruction in medicine at Toulouse and then traveled around Europe to the various medical centers to increase his knowledge and experience. His wanderings carried him to Montpellier, Bologna, and Paris and possibly to Prague, and at the end of this period, having become grounded in medicine, he considered himself equipped to take up the study and practice of surgery. In this he followed the dictates of his predecessor, Henri de Mondeville, and expressed his belief when he discusses the qualifications of the surgeon and laid down as one of these qualifications, "It is thus requisite in the first place that the surgeon be learned, not only in the principles of surgery but also in those of medicine both in the theory and in the practice." He also stressed the necessity for a knowledge of anatomy and was, for his time, an excellent anatomist.

Guy's principal work was his *Great Surgery;* so called because he is supposed to have written a *Little Surgery*, but doubt has been cast upon his authorship of the latter and it has been attributed to another author. The *Great Surgery* was written when he was over sixty years of age and with the desire to pass his knowledge of the Surgery of the ancients and the results of his own experience on to others. He was then physician and canon to Pope Urban V as he had been to his predecessors Clement VI and Innocent VI. He says he is writing the work also "Partly for myself as a solace in my old age and to exercise my mind, and to you Messieurs the physicians of Montpellier, Bologna, Paris, and Avignon, principally those of the Popes who have been my companions in the service of the Roman Pontiffs, with whom I have been sustained in guarding against mediocrity by listening, reading, and operating. I will state with a moderate abbreviation the principal things that the sages and wise men have spoken or written in many volumes of books on surgery. Wherefore this book will be called the inventory or collection of Surgery."

Guy succeeded so well in his task that his work became the standard reference work and textbook in surgery for centuries and he was called the father of modern surgery. His knowledge of his subject was marvelous, and his ability to express this knowledge in clear and lucid style was unsurpassed, though in actual contents the book is just what he tried to make it, a review of the best there was in surgery. Passed on in manuscript form for over a century it was first printed in 1478 and from then on until the seventeenth century.

In 1579 Laurent Joubert, Chancellor of the University of Montpellier, published the best French edition of Guy's surgery up to that time. Joubert consulted all the printed editions and many of the manuscripts and, after many years' study produced the volume, the title page of which is shown. It was printed at Lyon by Michel Estienne at the Stephanus Press following the then beginning custom of printing medical books in the vernacular. Joubert, however, edited a Latin edition which was printed at Leyden six years later.

REVIEWS OF NEW BOOKS IN SURGERY

IN the preface to Nelson's new system of surgery[1] of which six volumes are here reviewed, Dr. Whipple says: "This treatise as it is published, is a presentation of the surgery of today. But surgery is progressive. As reliable and proven advances are made in the various fields here discussed, additions will be made and revisions undertaken by the present and future contributors."

Volume I. Joshua E. Sweet, professor of surgical research at Cornell University Medical College, has written the section on "Physiology in Surgery." Frank L. Meleney, of the College of Physicians and Surgeons of Columbia University has written a masterly treatise of some 130 pages under the title of "Bacteriological and Immunological Aspects of Surgery." Virginia K. Frantz, with the collaboration of Arthur P. Stout and William C. Clarke, of Columbia University, furnish the section on Surgical Pathology. A most interesting chapter is that of Professor Walton Martin of Columbia University on "Surgical Infection." James T. Gwathmey has contributed the chapter on "General Anesthesia" and Gaston Labat that on "Local Anesthesia."

Volume II. The section on tumors, comprising 122 pages, is contributed by Francis Carter Wood, director of cancer research at Columbia University. Astley P. C. Ashhurst, professor of surgery at the University of Pennsylvania, has written a chapter on "Surgery in Malignant Disease." A section on "Surgery in Diabetes" is furnished by Edwin T. Hauser, and Professor Nellie B. Foster of Cornell University. The surgery of tuberculosis, with comprehensive section on surgery in pulmonary tuberculosis, is given by Professor Edward Archibald of McGill University.

The three hundred pages devoted to neurosurgery constitute an excellent textbook of that subject. Professor Wilder Penfield, of Columbia University, has written the "Principles of the Pathology of Neurosurgery." The "Surgery of the Brain" (excluding skull fractures and trigeminal neuralgia), is by Gilbert Horrax, of Harvard University. Professor of neurological surgery at Columbia University, Charles A. Elsberg, has contributed "The Surgical Diseases and Surgery of the Spinal Cord." The 136 pages devoted to the surgery of nerves is by Byron Stookey, assistant professor of neurology and neurosurgery, Columbia University. Professor Foster Kennedy of Cornell University has written a valuable chapter on traumatic psychoneuroses. Robert H. Ivy, professor of maxillo-facial surgery, University of Pennsylvania, has furnished the chapters on the surgery of the mouth and jaws. George W. Crile and R. S. Dinsmore of Cleveland, contribute the "Surgery of the Thyroid Gland." This exceedingly valuable section is most lucidly written. The very complete chapter on the "Surgery of the Neck" is written by George H. Semken, of the New York Skin and Cancer Hospital.

Volume III. The first section, by Nathaniel Allison, professor of orthopedic surgery at Harvard Medical School, forms a concise and authoritative textbook of orthopedic surgery. E. L. Eliason, professor of clinical surgery, University of Pennsylvania Medical School, has contributed the sections on dislocations and fractures. William O'Neill Sherman, chief surgeon of the Carnegie Steel Company, is the author of the chapter on the "Operative Treatment of Fractures." The very excellent section on the surgery of the hand, is by Hugh Auchincloss, professor of clinical surgery, College of Physicians and Surgeons, Columbia University. This writer makes full acknowledgments to the pioneer work of Kanavel. The illustrations of this section are remarkably fine. The section on amputations by Philip D. Wilson, instructor in orthopedic surgery, Harvard Medical School, is the best monograph on this subject which the reviewer has seen. Dallas B. Phemister, professor of surgery, University of Chicago, has written a very excellent chapter on "Pyogenic Osteomyelitis." The concluding chapters of this volume are on "Varicose Veins, Varicose Ulcer, Thrombophlebitis and Postphlebitic Induration of the Lower Extremities" by John Homans, instructor in surgery, Harvard Medical School; "Thrombo-Angitis Obliterans" by Leo Buerger (author of "Circulatory Disturbances of the Extremities"); and "Conditions Dependent upon Vasomotor Changes in Blood Vessels" by René Leriche, the eminent professor of surgery, University of Strasbourg.

Volume IV. This volume has been sent out before completion. The chapters on the "Surgery of the Thorax," by Professor George J. Heuer, of the University of Cincinnati College of Medicine, and on the "Surgery of the Breast," by Professor Hugh Auchincloss, of the College of Physicians and Surgeons, Columbia University have not been printed but will be forwarded by the publishers for insertion in this volume. Emmet Rixford, professor of surgery, Stanford University Medical School, has contributed a chapter on the "Surgery of the Lymphatic System." In the 104 pages devoted to "The Surgery of the Œsophagus," by Franz Torek, of the Lenox Hill Hospital, New York, this subject is most ably and completely handled. Elliott C. Cutler, professor of surgery, Western Reserve University, and Claude S. Beck, instructor in surgery, Western Reserve University, have contributed the section on the "Surgery of the Heart and Pericardium." The section on hernia is written by Professor Seward Erdman, of the College of Physicians and Surgeons, Columbia University and the New York Hospital.

[1] NELSON'S LOOSE-LEAF LIVING SURGERY. A loose-leaf system of surgery published in eight fully illustrated volumes and an index. Editor-in-Chief, Allen O. Whipple, Professor of Surgery, College of Physicians and Surgeons, Columbia University; and Associate Editor, Fordyce B. St. John, Professor of Surgery, College of Physicians and Surgeons, Columbia University. New York: Published by Thomas Nelson and Sons, 1927.

Volumes V and VI. The high standard set by the first four volumes of Nelson's Loose-Leaf Surgery is maintained in Volumes V and VI which have just been issued. Volume V, which is devoted to abdominal surgery, is incomplete, the papers of Professor Alessandri, of Rome, on the "Surgery of the Liver," and of Professor Ochsner, of Tulane, on "Surgery of the Intestines" are absent, but may readily be inserted in the loose-leaf binder when supplied.

The very valuable chapter on "Peritonitis" is by Joseph A. Blake.

A. J. Walton, of London, England, has contributed 120 pages on the "Surgery of the Stomach and Duodenum."

Vernon C. David has furnished the "Surgery of the Rectum and Anus" with the exception of "Malignant Disease of the Rectum," which is by Daniel F. Jones.

The chapter on "Appendicitis" is by Roger T. Vaughan; and Eugene H. Pool and Ralph Stillman are the authors of the excellent section on the "Surgery of the Spleen."

The "Surgery of the Pancreas" is by John Speese. The Editor-in-Chief, Professor Allen O. Whipple, has chosen for his subject the Surgery of the Biliary System, and has made it a most complete and valuable chapter.

Volume VI is devoted entirely to the subject of urology, and many of the country's most eminent urologists have combined to make it an extremely valuable text of that subject. The surgery of the urethra and penis, and of the scrotum, testicles, and groin, are by Franklin P. Johnson and Francis R. Hagner, respectively.

Hugh H. Young has contributed the chapter on the "Surgery of the Prostate" which includes a section on "Suprapubic Prostatectomy" by Alexander Randall. William C. Quinby has written the "Surgery of the Seminal Vesicles" and William R. Fronty that of the "Bladder" with the exception of "Congenital Anomalies, Tumors, and Diverticulum," which is by J. A. C. Cotston.

The chapter on "Renal Structure and Function" is by Frank Hinman, and that on "Nephrolithiasis" by H. A. Fowler.

The volume is concluded by chapters on "Tuberculosis and New Growths of the Kidney," by David M. Davis; on "Cystoscopy and Urethroscopy" by A. R. Stevens, and on "Laboratory Urology and Experimental Work" by Edwin Davis.

The mechanical details of the loose-leaf feature, already familiar to many through Nelson's Loose-Leaf Medicine, are excellent. The binding covers are strong and rigid, yet readily permit opening and reading of the volumes. The extra pages may be quickly and securely placed in the binder. Genuine Morocco binding enhances the appearance. The price charged subscribers for the renewal pages includes membership in Nelson's Research Service Bureau which will supply, when requested, without further charge, special information upon any surgical subject.

The reviewer considers the six volumes of Nelson's Loose-Leaf Surgery here reviewed to be an extremely valuable addition to the surgeon's reference library. The contributors are authoritative and the articles are well written. The editors and publishers may be congratulated upon accomplishing so successfully their aims, namely the presentation of a "Surgery of Today." FREDERICK CHRISTOPHER.

SIR WARING'S *Manual*[1] is written in the usual form of single volume books on operative surgery: an introductory chapter on surgical technique is followed by chapters on regional surgery—surgery of the stomach and intestines, repair of hernia, surgery of the biliary system, spleen, and pancreas, urologic and gynecologic surgery, etc. There are also chapters on otolaryngology and on ophthalmic operations. The volume is arranged in a systematic manner and is compact. While the various subjects are necessarily only briefly covered, the work is encyclopædic in its scope and is a valuable desk reference work for practitioners as well as students.

J. R. BUCHBINDER.

MALIGNANT disease, the curse of the human race, is ever confronting the medical profession. The general practitioner in some remote part of the world is no less interested than the cancer specialist in the large medical center. Whatever information that is of practical value which is and can be assembled in usable form is of value to humanity only so far as it can be put into the hands of the physician who must treat the afflicted ones. Such a publication of value is Sir Waring's *Surgical Treatment of Malignant Disease*.[2] The author's original idea of the treatment of malignant disease was briefly expressed in his Bradshaw lecture in 1921. This led to an analysis of the cases treated at St. Bartholomew's hospital and the collection of a large amount of data from the clinics the world over. In this Oxford monograph, the author presents an assembly of these facts in a classified description of malignant disease from a clinical and surgical aspect, the pathological view being considered only insofar as it has a bearing on diagnosis and treatment. Every phase of malignant disease of the body is covered, in some instances in an excellent manner, in others in a less graphic and questionable way. The discussion on malignant disease of the tongue, mouth, pharynx, and larynx is unusually complete. The use of barium sulphate in the bladder as a contrast media for X-Ray study of carcinoma must be seriously questioned, especially since sodium iodide or bromide has yielded such positive results in the X-Ray studies of the urinary tract. A careful reading of the chapters on malignant disease of the bones will show that the author considers sarcoma a disease which offers a poor prognosis, yet a less careful study by one not familiar

[1] MANUAL OF OPERATIVE SURGERY. By Sir Holburt J. Waring, M.S., M.B., B.Sc. (Lond.), F.R.C.S. 6th ed. New York: Oxford University Press, 1928.

[2] THE SURGICAL TREATMENT OF MALIGNANT DISEASE. By Sir Holburt J. Waring, M.S., M.B., B.Sc. (Lond.), F.R.C.S. New York and London: Humphrey Milford, Oxford University Press, 1928.

with the subject might convey the opposite impression as the author frequently refers to exceptional cures. More information on the diagnosis of bone sarcoma would be of distinct value.

Many chapters can be praised and not a few criticized for lack of specific detail and possible difference of opinion, yet here is a book of some 700 pages devoted to the common subject of malignant disease from a clinical viewpoint. A large number of statistics are included. It offers the reader, in a concise form without frills, an enormous amount of information regarding the treatment of malignant disease. No work is or can be complete and differences of opinion—purely constructive criticism—must always obtain. The references at the close of each chapter are abundant and add distinctly to the value of the work. Withal it is an assembly of a large amount of valuable information, tempered by the knowledge of a surgeon of unusual experience. J. A. WOLFER.

THE conservative surgeon is giving more and more consideration to anæsthesia, its choice, individual application, and effect. As a result we find record of far fewer postoperative complications not to mention a lower mortality rate. The selection of an anæsthesia should be dependent upon the type of patient and his ability to bear a contemplated operation. The available technical ability and facilities should also be considered. The selection of the anæsthesia should by no means be based upon the dogged determination of the surgeon to choose either a local or general anæsthesia as a routine. The advocate of local anæsthesia must remember that in not a few cases a well administered nitrous oxide gas, ether, or ethylene anæsthesia may be best for his patient while the average surgeon who uses only general anæsthesia could profitably employ local anæsthesia in an increasingly large number of selected cases. No doubt one of the potent factors which causes this lack of knowledge as to the value of local anæsthesia is the result of the complex and verbose methods in which local anæsthesia is presented to the surgical profession and of the lack of systematic teaching of the subject to the undergraduate student.

In his recent monograph[1] de Takats endeavors to cover, in a rather brief and didactic manner, the general scope of local anæsthesia as he is teaching the subject to the undergraduate and postgraduate medical student. He states in the preface: "The student should feel that local anæsthetic methods are a part of his surgical training and that he can acquire these without the difficulty of working himself into a complicated new field—a new specialty. This is not a specialty, it is an improvement of surgical technique which is open and accessible to every prospective and active surgeon and which will bring gratifying results in his morbidity and mortality statistics."

The author makes no claim to originality but presents to the reader in a concise manner the fundamental principles upon which the technique is dependent. Many illustrations clarify and amplify the text. It is pleasing to note that specific contraindications to local anæsthesia are frequently mentioned.

The reviewer is personally acquainted with the author's scheme of teaching the subject as well as with the usual technique employed in many types of individual application. There can be no question but that the portrayal in this small text is accurate and well within the scope of the average graduate or even under-graduate student's comprehension. The surgeon will find it a brief and satisfactory text that will bring to his attention the essential and salient points of local anæsthesia. J. A. WOLFER.

THEW WRIGHT'S little book on appendicitis,[2] written for the lay public, is really remarkable in that it presents a very complicated subject in such a clear and forceful manner. It contains a concise review of the anatomy without making the subject burdensome. It analyzes the etiology and symptoms in such a way that the reader does not get the impression that he has appendicitis or is not led to have an undue terror of the disease. It especially emphasizes the fact that discomfort and occasional pain in the right lower quadrant are not necessarily caused by the appendix.

In his outline of treatment, it seems to me that Dr. Wright has emphasized the most important details: the dangers of cathartics, the dangers of delay, and the inability of any surgeon or medical man to state what will happen in the course of the disease. He especially emphasizes the fact that the patient does not die as a result of the operation, but in spite of it.

On the whole, I consider this book a very fine presentation of the subject of appendicitis; it may be read with benefit by the medical profession and will be of great value to the lay public.

WM. R. CULLINS.

[1] LOCAL ANESTHESIA. By Géza de Takats, M.D., M.S. With foreword by Allen B. Kanavel, A.B., M.D., D.Sc. Philadelphia and London: W. B. Saunders Company, 1928.

[2] APPENDICITIS. By Thew Wright, A.B., M.D., F.A.C.S. New York: Allen Ross & Company, 1928.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GEORGE D. STEWART, New York, *President* FRANKLIN H. MARTIN, Chicago, *Director-General*

BOSTON COMMITTEE ON ARRANGEMENTS

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JAMES S. STONE
LORING T. SWAIM
HAROLD WALKER
WYMAN WHITTEMORE
HANS ZINSSER

COMPLETE PROGRAM FOR THE 1928 CLINICAL CONGRESS IN BOSTON

THE surgeons of Boston have prepared and will present a highly attractive program of clinics and demonstrations in the hospitals and medical schools of that city during the eighteenth annual Clinical Congress of the American College of Surgeons, beginning Monday, October 8th, and continuing through Friday, October 12th. The clinical program will completely represent the clinical activities of that great medical center in all departments of surgery. A schedule of clinics and demonstrations prepared by the Committee on Arrangements, under the leadership of Dr. Frederic J. Cotton, Chairman, will be found in the following pages. The real clinical program of the Congress will be issued daily in the form of bulletins that will be posted at headquarters each afternoon giving a complete and accurate schedule of the clinics and demonstrations that are to be given at each of the hospitals on the following day. Printed programs will be distributed each morning.

For those whose practice is confined to ophthalmology and otolaryngology, the Committee has prepared, in addition to clinics and demonstrations during the morning hours of each day, a series of clinical demonstrations and conferences on Tuesday, Thursday and Friday afternoons to be presented in the Georgian Room at the Statler Hotel. The program for these sessions will be found in the following pages. On Wednesday afternoon in the same room a symposium dealing with the principles involved in the standardization of eye, ear, nose and throat departments in general hospitals will be presented.

General headquarters for the Clinical Congress will be established at the Statler Hotel where the ballroom, foyer and other large rooms on the mezzanine floor have been reserved and will be used for registration and ticket bureaus, bulletin boards, technical exhibition, executive offices, etc. Headquarters will be open for registration at 8 o'clock on Monday morning, October 8th. The ballroom at the Copley-Plaza Hotel will be utilized for evening meetings, hospital conferences, the annual meeting and other large gatherings.

A special feature of this year's meeting will be the showing of several surgical films that have been produced under the supervision of and approved by the American College of Surgeons. A number of such films will be given their premier showing at Boston. In addition, it is planned to show a number of surgical films that have been made in England and France.

A feature of the Boston meeting that will be of interest to all surgeons will be the celebration of Ether Day at the Massachusetts General Hospital on Friday. Exercises will be held at 11 o'clock in the dome room of the old building of the hospital where ether was first administered

for the production of surgical anæsthesia on October 16, 1846. On this occasion a bronze bust of William T. G. Morton will be presented to the hospital.

In addition to those surgeons from abroad whose names appear in the program for the evening meetings, there will be present at this year's Congress a number of distinguished surgeons from various parts of the world including: Sir George A. Syme, of Malvern, Australia, President of the Australasian College of Surgeons; George E. Waugh, Thomas P. Dunhill, and Percy T. Hughes, of London, England; T. de Martel, of Paris, France; Charles G. F. Morice, of Wellington, New Zealand; Farquhar Macrae, of Glasgow, Scotland; Daniel J. Cranwell, of Buenos Aires, Argentina; Louis L. Cassidy and Charles J. MacAuley, of Dublin, Ireland; Ulises Valdes and Rafael Reygades, of Mexico City, Mexico.

EVENING MEETINGS

The general program as prepared by the executive committee includes evening sessions on each of the five days of the Congress. The complete program for these evening sessions will be found in the following pages. The Presidential Meeting on Monday evening and the Convocation on Friday evening are to be held in Symphony Hall. On Tuesday, Wednesday and Thursday evenings meetings will be held in the ballroom of the Copley-Plaza Hotel. At the Presidential Meeting on Monday evening the President-Elect, Dr. Franklin H. Martin of Chicago, will be inaugurated and will give the annual address. On the same evening the Murphy Oration in Surgery will be delivered by Professor Vittorio Putti, professor of orthopedic surgery in the university at Bologna, Italy, and Director of the Rizzoli Institute. At the Convocation on Friday evening the Fellowship Address will be delivered by Dr. William J. Mayo.

On Wednesday evening the visiting surgeons will be guests of the Boston Surgical Society at a special session at which the Henry J. Bigelow Medal is to be presented to Professor Chevalier Jackson of Philadelphia.

OPEN FORUM AND SYMPOSIUM ON TRAUMATIC SURGERY

An open forum on traumatic surgery has been planned for Friday morning at the Copley-Plaza Hotel beginning at 10 o'clock; and in the afternoon at 2 o'clock a more formal presentation of the subject, at which time papers will be presented without open discussion. For the morning session a number of subjects have been selected and men chosen to give five minute talks thereon, following which there will be a general discussion. The program for the open forum is as follows:

LOYAL A. SHOUDY, M.D., Bethlehem, Pa.: What Relation Should Exist between an Industrial Medical Department and the Other Executives of the Industry?

FRED G. HUGHES, Bristol, Conn.: What Are the Essential Features in the Physical Equipment of an Industrial Medical Department? (Illustrated.)

A. D. LAZENBY, M.D., Baltimore, Md.: How Can Economies be Introduced in the Care of the Injured?

DONALD A. GUTHRIE, M.D., Sayre, Pa.: What Are the Advantages and Methods of Supervision of Traumatic Surgery in a Hospital?

DONALD B. CRAGIN, M.D., Hartford, Conn.: What is the Place of Physical Therapy in the Care of the Injured?

EARL W. WILLIAMSON, M.D., Chicago: What are Some of the Defects in the Organization for Care of the Injured, as Seen in a Large City?

The following program for the symposium in the afternoon has been prepared:

FREDERIC A. BESLEY, M.D., Chicago, Chairman, Professor of Surgery, Northwestern University Medical School: Report of Board on Traumatic Surgery.

IRVING S. CUTTER, M.D., Chicago; Dean, Northwestern University Medical School: Traumatic Surgery as an Educational Problem.

JOHN P. FREY, Washington, D. C., American Federation of Labor: The Relation of Organized Labor to the Care of Accidents.

LINDSAY ROGERS, Ph.D., LL.D., New York, Professor of Public Law, Columbia University: Some Aspects of the Medical Situation under the New York Workmen's Compensation Act.

THOMAS P. HENRY, President of American Automobile Association: The Care of Injuries, from the Standpoint of the Motorist.

DAVID BEYER, Boston, Director of National Safety Council: Prevention of Accidents.

In connection with the meetings on Friday dealing with various aspects of traumatic surgery, it is important to note that a series of clinics in industrial surgery has been prepared for each afternoon to be held in the medical department of the American Mutual Liability Insurance Company. A detailed schedule of these clinics will be found in the preliminary clinical program.

ANNUAL MEETING

The annual meeting of the Fellows of the College will be held at 2 o'clock on Thursday afternoon in the ballroom of the Copley-Plaza Hotel; reports of officers and standing committees will be presented and officers elected for the ensuing year.

Following the annual meeting there will be presented a symposium on the "Treatment of Malignant Diseases with Radium and X-ray," which will include a special report on the treatment of cancer of the breast. The complete program for this session appears on another page.

HOSPITAL CONFERENCE

The eleventh annual hospital conference of the American College of Surgeons opens on Monday morning at 10 o'clock with a session in the ballroom of the Copley-Plaza Hotel. The program for the hospital conference, which calls for morning and afternoon sessions in the same room on the following days and which is published complete in the following pages, provides an interesting series of papers, practical demonstrations and round table conferences dealing with numerous problems related to hospital efficiency.

A special session on Wednesday afternoon will be of particular interest to those whose practice is confined to surgery of the eye, ear, nose and throat. The papers that afternoon comprise a symposium dealing with the principles involved in the standardization of such special departments in general hospitals.

During the Clinical Congress there will be a meeting of hospital record librarians to be held at the Copley-Plaza Hotel. An interesting and instructive program of practical papers and demonstrations has been prepared, dealing with a number of the problems associated with the maintenance of case records in the hospitals. A model record room will be on exhibition.

The hospital conference program is planned to interest not only surgeons but also hospital trustees, executives and personnel generally, and an invitation is extended to all persons who are interested in hospital activities to attend.

SPECIAL TRAIN FROM CHICAGO

For the convenience of Fellows living in the central and western states, who will attend the Boston meeting, arrangements have been made with the New York Central Lines to provide a special train leaving Chicago at 9 A.M. on Sunday, October 7th, arriving in Boston at 9 A.M. on Monday. The special train will be equipped with all-steel cars of latest design, including club, compartment, observation, sleeping and dining cars. No extra fare will be charged. The train will arrive at Cleveland at 5:28 P.M., making connections there with regular trains over the Big Four from Indianapolis and Cincinnati. This arrangement is contingent upon reservations for such a special train being made by the minimum number required by the Interstate Commerce Commission rules. Fellows are urged to make their reservations for the special train at the earliest possible date, making application at the office of the assistant general passenger agent of the New York Central Lines, LaSalle Street Station, Chicago.

REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Boston session of the Clinical Congress, so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates it is necessary to pay the full one-way fare to Boston, procuring from the ticket agent when purchasing ticket a "convention certificate" which certificate is to be deposited at headquarters for the visé of a special agent of the railways. Upon presentation of a viséed certificate to the ticket agent in Boston not later than October 16th a ticket for the return journey by the same route as traveled to Boston may be purchased at one-half the regular one-way fare.

In the eastern, central, and southern states and eastern provinces of Canada, tickets may be purchased between October 4th and 10th; in southwestern and western states between October 3d and 9th, and in the far western states and western provinces of Canada between September 30th and October 6th. The return journey from Boston must be begun not later than October 16th.

The reduction in fares does not apply to Pullman fares, nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Boston, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséed by a special railroad agent in Boston during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Boston and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 16th.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific Coast states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in the Pacific Coast states and British Columbia. Tickets sold

at summer excursion rates permit traveling to Boston via one direct route and returning via another direct route, with liberal stop-over privileges.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Boston session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets, which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding, the number of tickets issued for any clinic being limited to the capacity of the room assigned to that clinic.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fee providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is nontransferable, must be presented to secure clinic tickets and admission to the evening meetings.

BOSTON HOTELS AND THEIR RATES

Since the last Clinical Congress in Boston in 1922, a number of new hotels have been built, including the Statler with 1300 guest rooms, the New Parker, and the Ritz-Carlton. Some of the older hotels have been enlarged so that there are now ample first-class hotel accommodations in Boston for all who wish to attend the Clinical Congress. Many of these hotels are located within short walking distance of the headquarters of the Congress.

	Minimum Rates with Bath	
	Single Room	Double Room
Bellevue, 21 Beacon St	$4.00	$7.00
Braemore, 464 Commonwealth Ave	4.00	7.00
Brunswick, Boylston and Clarendon Sts	3.50	5.00
Buckminster, 645 Beacon St	3.00	4.00
Canterbury, 14 Charlesgate West	4.00	5.00
Charlesgate, Charlesgate East	3.00	5.00
Copley-Plaza, Copley Square	4.00	7.50
Elks, 275 Tremont St	3.50	5.00
Fensgate, 534 Beacon St	4.00	5.00
Gralyn, 20 Charlesgate West	3.00	5.00
Kenmore, 496 Commonwealth Ave	3.50	6.00
Lenox, Exeter and Boylston Sts	3.50	4.50
Lincolnshire, 20 Charles St	4.00	6.00
New Parker, Tremont and School Sts	3.50	5.50
Puritan, 390 Commonwealth Ave	3.50	5.00
Ritz-Carlton, Arlington and Newbury Sts	5.00	8.00
Sheraton, 91 Bay State Road	5.00	6.00
Somerset, 400 Commonwealth Ave	3.00	5.00
Statler, Park Square at Arlington St	3.50	5.50
Touraine, Boylston and Tremont Sts	5.00	7.50
Vendome,* Commonwealth and Dartmouth	8.00	16.00
Victoria, Dartmouth and Commonwealth	4.00	6.00
Westminster, Copley Square	3.00	5.00

*American plan.

CANCER SYMPOSIUM

Thursday, October 11—Ballroom, Copley-Plaza Hotel, 3:30 P.M.

ROBERT B. GREENOUGH, M.D., Boston (Chairman of the Committee on the Treatment of Malignant Diseases with Radium and X-ray): Report of the Committee.

JAMES F. PERCY, M.D., Los Angeles: Statistical Report of Cautery Surgery in Uterine Cases.

GEORGE GRAY WARD, M.D., New York: Radium Therapy in Carcinoma of the Cervix Uteri.

WALTER E. SISTRUNK, M.D., ROCHESTER, Minn.: Criteria of Malignancy in Cancer of the Breast.

GEORGE W. HOLMES, M.D., Boston. Results of X-ray Treatment in Cases of Cancer of the Breast.

PROGRAM FOR EVENING MEETINGS

Presidential Meeting, Monday, October 8—Symphony Hall, 8:15 P.M.

Address of Welcome: FREDERIC J. COTTON, M.D., Boston, Chairman of Committee on Arrangements.

Address of Retiring President: GEORGE DAVID STEWART, M.D., New York.

Introduction of Foreign Guests.

Inaugural Address: The Evolution of Clinical Medicine and Surgery in Relation to the Preservation of Health and Life. FRANKLIN H. MARTIN, M.D., Chicago.

The John B. Murphy Oration in Surgery: Malignant Bone Tumors. PROFESSOR VITTORIO PUTTI, Bologna, Italy.

Tuesday, October 9—Ballroom, Copley-Plaza Hotel, 8:15 P.M.

Hunterian Oration: Grand Curiosity. SIR SQUIRE SPRIGGE, M.D., B.Ch., F.R.C.S., London.

Symposium: Ureteral Transplantation.

ROBERT C. COFFEY, M.D., Portland, Oregon: Transplantation of Ureters into the Large Bowel.

CHARLES M. MCKENNA, M.D., Chicago: End-Results in Transplantation of Ureters.

ARTHUR H. CURTIS, M.D., Chicago: Notes on (1) Management of Ureteral Injuries; (2) Surgical Indications in Patients Who Require Ureteral Transplants.

CHARLES H. MAYO, M.D., Rochester, Minn.: Contributing Causes of Genito-Urinary Anomalies.

Discussion: GEORGE GILBERT SMITH, M.D., and WILLIAM CARTER QUINBY, M.D., Boston.

Wednesday, October 10—Ballroom, Copley-Plaza Hotel, 8:30 P.M.

Special Meeting of the Boston Surgical Society: Presentation of the Henry J. Bigelow Medal.

CHEVALIER JACKSON, M.D., Philadelphia: Bronchoscopy—Past, Present, and Future.

Thursday, October 11—Ballroom, Copley-Plaza Hotel, 8:15 P.M.

PROFESSOR ARCHIBALD YOUNG, M.B., C.M., F.R.F.P.S., Glasgow: Sacrococcygeal Chordoma.

SIR CHARLES BALLANCE, K.C.M.G., C.B., M.V.O., London: Some Thoughts on the Nature of Cancer.

GEORGE W. CRILE, M.D., Cleveland: The Adrenal Factor in Hyperthyroidism.

COLONEL SIR JOHN LYNN-THOMAS, K.B.E., C.M.G., C.B., F.R.C.S., Llechryd, Wales: Motion pictures on orthopedic subjects, with introductory remarks.

Convocation, Friday, October 12—Symphony Hall, 8:15 P.M.

Conferring of Honorary Fellowships.

Presentation of Candidates for Fellowship.

Presidential Address: The American College of Surgeons—the Past, the Present, and the Future. FRANKLIN H. MARTIN, M.D., Chicago.

Fellowship Address: The Education of the Surgeon. WILLIAM J. MAYO, M.D., Rochester, Minnesota.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS

BOSTON CITY HOSPITAL

Monday

NATHANIEL R. MASON, ROBERT M. GREEN, JOHN T. WILLIAMS, FREDERICK L. GOOD, JOSEPH P. COHEN, HAROLD V. HYDE, FREDERICK J. LYNCH, REGINALD D. MARGESON, PIERCE J. DUNPHY, ABRAHAM S. TROUPIN and CARMI R. ALDEN—2. Gynecological and obstetrical operations and demonstration of cases.

Tuesday

DAVID D. SCANNELL, SOMERS FRASER and JAMES J. HEPBURN—9. General surgical operations.

HORACE BINNEY, WILLIAM R. MORRISON and GEORGE W. PAPEN—9. General surgical operations.

WILLIAM R. MORRISON and ARTHUR R. KIMPTON—2. Dry clinic: Perforated ulcers of the stomach and duodenum.

FRANKLIN W. WHITE and WILLIAM R. MORRISON—2:25. Intussusception of the bowel occurring within the stomach following gastro-enterostomy.

HORACE BINNEY—2:50. Thoracoplasty for bronchiectasis; series of fractures.

GEORGE C. SHATTUCK—3:15. Surgical aspects of some tropical maladies.

JAMES J. HEPBURN—3:40. Postoperative hernias.

WILLIAM R. OHLER—3:55. Care of the surgical diabetic.

GEORGE W. PAPEN—4:15. Menacing ovarian hæmorrhage in acute abdominal surgery; total subperiosteal resection of the tibia with preservation of both epiphyses and complete function of ankle and knee.

Wednesday

HALSEY B. LODER, EDWARD HARDING and THOMAS W. WICKHAM—9. General surgical operations.

IRVING J. WALKER, ROBERT C. COCHRANE, AUGUSTUS RILEY, THOMAS K. RICHARDS and CHARLES C. LUND—9. General surgical operations.

CHARLES C. LUND—2. Dry clinic: The influence of changes in the basal metabolism on the action of morphine.

ROBERT C. COCHRANE—2:25. Demonstration of thyroid cases at Boston City Hospital during past year.

HALSEY B. LODER—2:50. Demonstration of series of cases of undescended testicle.

IRVING J. WALKER—3:15. End-results in gall-bladder surgery.

AUGUSTUS RILEY—3:45. Nephropexy for kinked ureters with lantern slides of pre- and postoperative conditions.

THOMAS W. WICKHAM—4:05. Review of cases of intestinal obstruction complicating convalescence of acute appendicitis.

Thursday

FREDERIC J. COTTON, OTTO J. HERMANN, JOSEPH H. SHORTELL and JOSEPH H. BURNETT—9. General surgical operations.

ARTHUR R. KIMPTON, HERBERT H. HOWARD, DONALD MUNRO and TRACY PUTNAM—9. General surgical operations.

MARTIN J. ENGLISH and OTTO J. HERMANN—2. Dry clinic: Appendicitis in children.

FREDERIC J. COTTON—2:25. Dry clinic: Hip fractures; "fender fracture" of knee; arthroplasty of knee; elbow dislocation with ulnar nerve lesion; fourth class of ankle fracture.

JOSEPH H. SHORTELL—2:50. Dry clinic: Drainage of septic joints; subastragaloid arthrodeses of fractured os calces; late suture of severed ulnar nerve.

OTTO J. HERMANN and WILLIAM R. MORRISON—3:10. Dry clinic: Several cases of open reductions and fixations of fractured tibia under spinal anæsthesia with Pitkins solution; convalescing case of osteomyelitis of ilium with hæmolytic streptococcus septicæmia.

DONALD MUNRO—3:25. Fracture of cervical spine; fractional section of the root of fifth nerve for major neuralgia.

MAURICE FREMONT-SMITH—3:45. Mechanism of hydrocephalus.

HERBERT H. HOWARD—4:05. Diverticulum of the bladder; three cases of carcinoma of the bladder.

Friday

Surgical staff—9. Conferences and presentation of special subjects.

FREDERIC J. COTTON. Hip fractures.

R. W. ANDREWS (Poughkeepsie, N. Y.). Impaction in hip fractures.

FRANK B. MALLORY. Pathology of bone lesions.

OTTO J. HERMANN. Fractures of os calcis.

PAUL F. BUTLER. Lesions of the large bowel.

JOSEPH H. SHORTELL. Carpal injuries.

JOSEPH H. BURNETT. Scaphoid fractures.

M. BERLIN (by invitation). Position in treatment of scaphoid fractures.

LONG ISLAND HOSPITAL

Monday

J. H. CUNNINGHAM and C. S. SWAN—2. Genito-urinary clinic, operations and demonstration of cases.

CHARLES LUND—2. The use of surgical diathermy in cancer of the tongue and mouth.

EARLE C. CLARK—2. Surgical pathology.

H. R. VIETS—2. Neurosurgical features pertaining to surgery.

A. B. MACMILLAN—2. Surgical X-ray demonstration.

Wednesday

ROBERT SOUTTER—2. Orthopedic clinic, operations and demonstration of cases; traction in the treatment of fractures; treatment of congenital hip.

EARLE C. CLARK—2. Surgical pathology.

H. R. VIETS—2. Neurosurgical features pertaining to surgery.

A. B. MACMILLAN—2. Surgical X-ray demonstration.

CHARLES LUND—2. Injection treatment of varicose veins; operations and demonstration of cases.

Friday

J. H. CUNNINGHAM and C. S. SWAN—2. Genito-urinary operations.

ROBERT SOUTTER—2. Orthopedic operations.

CHARLES LUND—2. General surgical operations.

EARLE C. CLARK—2. Surgical pathology.

H. R. VIETS—2. Neurosurgical features pertaining to surgery.

A. B. MACMILLAN—2. Surgical X-ray demonstration.

MASSACHUSETTS GENERAL HOSPITAL

Monday

Orthopedic Staff—2. Dry clinics.
NATHANIEL ALLISON. Tuberculosis of the knee.
P. D. WILSON. Tuberculosis of the spine.
N. M. SMITH-PETERSEN. Tuberculosis of the sacro-iliac.
R. K. GHORMLEY. Internal derangements of the knee.
NATHANIEL ALLISON and ARMIN KLEIN. Congenital dislocation of the hip.
J. H. MEANS, E. P. RICHARDSON and GEORGE HOLMES—2. Thyroid clinic.
MONROE MCIVER—3. Observations of burns.
P. D. WHITE and HOWARD SPRAGUE—3:30. The heart in surgery.
G. A. LELAND—4. Fascial repair of hernia.
Surgical laboratories open from 2 to 4.

Tuesday

J. D. BARNEY, R. F. O'NEILL, G. G. SMITH, H. H. CRABTREE and F. H. COLBY—9. Genito-urinary clinic, operations and demonstration of cases.
Surgical Staff—11. General surgical operations and demonstration of cases.
W. J. MIXTER, J. B. AYER and J. S. HODGSON—2. Surgery of the nervous system, operations and demonstrations.
D. F. JONES—2. Cancer of the colon and rectum.
L. B. MCKITTRICK—3. Spinal anæsthesia.
C. A. PORTER—3:30. X-ray burns.
J. V. MEIGS—4. Uterine bleeding.
A. W. ALLEN and R. SMITHWICK—4:30. Circulatory diseases of the extremities.
Staff—2. Demonstrations in surgical research laboratories.
DRS. YOUNG, MALLORY and HARTWELL—3. "Cabot Clinic" (pathology).

Wednesday

Surgical Staff—9. General surgical operations.
DR. KAZANJIAN—12. Plastic surgery.
WYMAN WHITTEMORE and DR. LORD—2. Thoracic surgery, operations and demonstration of cases.
R. C. CABOT and MISS CANNON—2. Social service.
H. D. LLOYD and associates—3. Syphilis in surgery.
T. W. HARMER—3:30. Tendon and nerve sutures.
WILLIAM HERMAN—4:15. Psychiatry and surgery.
Surgical laboratories open for inspection from 2 to 4.

Thursday

Orthopedic Service—9. Operations and demonstrations.
P. D. WILSON and M. DANFORTH. Arthritis of the spine.
NATHANIEL ALLISON and KENNETH COONSE. Arthritis of the knee.
W. ROGERS and W. A. STRAMMER. Arthritis of the hip.
R. K. GHORMLEY and HARRY LOW. Poliomyelitis.
WILLIAM A. ROGERS. End-result studies.
Fracture Service—2. Demonstration of cases.
B. VINCENT—2. Surgery of the spleen.
E. P. RICHARDSON—2:30. Hernia through the cardiac orifice of the diaphragm.
Staff—2. Demonstrations in surgical research laboratories.
L. DAVIS—3. Cancer of the cæcum; the duodenum and common bile duct.
J. M. HANFORD (Presbyterian Hospital, New York), R. H. MILLER and W. M. SHEDDEN—2:30. Surgical tuberculosis; cervical adenitis.
E. M. DALAND—4:30. Plastic surgery.

Friday

"Ether Day Celebration"—11. Presentation of bust of Dr. W. T. G. Morton by the Associated Anæsthetists of the United States and Canada and the International Research Society.
ROBERT H. GREENOUGH, C. C. SIMMONS and associates—2. Tumor clinic.
GEORGE HOLMES and associates—3. X-ray and surgery.

PETER BENT BRIGHAM HOSPITAL

Monday

HARVEY CUSHING—2:30. Neurosurgical clinic.
FRANCIS NEWTON—3:30. Diverticulitis.
CHANNING FROTHINGHAM—4. Passing of the chronic appendix.
E. S. EMERY, JR.—4:30. Study of the results of medical and surgical treatment of peptic ulcer.

Tuesday

Staff—9:30. Surgical operations.
H. A. CHRISTIAN—2:30. Medical diagnostic and therapeutic clinic.
GILBERT HORRAX—3:30. Cordotomy for the relief of pain.
J. P. O'HARE—4. Hypertension and nephritis in relation to surgery.
DAVID CHEEVER—4:30. Surgical diagnostic clinic.

Wednesday

Staff—9:30. Surgical operations.
M. C. SOSMAN—2:30. X-ray study of massive atelectasis of the lung.
G. P. GRABFIELD—3. Effect of drugs on the nitrogen metabolism.
JOHN HOMANS—3:30. Treatment of varicose ulcer.
S. A. LEVINE—4. Heart disease in surgery.
S. B. WOLBACH—4:30. Demonstration in surgical pathology.

Thursday

Staff—9:30. Surgical operations.
W. C. QUINBY—2:30. Surgical clinic.
R. H. FITZ—3. Insulin in surgical conditions.
WILLIAM MURPHY and JOHN POWERS—3:30. Treatment of secondary anæmia by liver diet.
HARVEY CUSHING and TRACY PUTNAM—4. Pituitary gland and its influence on growth.

BOSTON DISPENSARY

Tuesday

H. J. INGLIS—2. Lipiodol injections in the diagnosis of bronchiectasis and lung abscess.
ARTHUR H. CROSBIE and HAROLD CHAMBERLAIN—2. Cystoscopy and demonstration of cases.
JOSEPH H. PRATT—2. Dry clinic, importance of the physician to the surgeon, illustrated by cases.

Wednesday

JOHN D. ADAMS—11. Orthopedic operations.
HILBERT F. DAY—11. Injection treatment of varicose veins; demonstration of technique, cases and pathological specimens.
HARRY FRIEDMAN—11. Demonstration of malignancies treated by radium and X-ray therapy.

Thursday

A. K. PAINE—2. Treatment of gonorrhœa in women.
WILLIAM A. HINTON—2. Hinton-cholesterol reaction; demonstration of technique and relative sensibility.
MAYNARD LADD—2. Surgical aspects of pyloric stenosis in infants.

HARVARD MEDICAL SCHOOL

Tuesday and Wednesday

DRS. WOLBACH and BLACKFAN—2. Hæmatological studies with special reference to splenectomy in children.

BRONSON CROTHERS—2. Studies of injuries to the spinal cord in infants.

W. LLOYD AYCOCK and E. H. LUTHER—2. Infantile paralysis: modes of spread, use of convalescent serum, experiments in immunity, and epidemiology of the disease.

W. B. CANNON—2. Complete denervation of heart; effects of total sympathectomy.

J. W. SCHERESCHEWSKY—2. Cancer, the use of high frequency currents.

CECIL K. DRINKER and STEPHEN WENT—2. New colloid solutions for intravenous injections as substitutes for simple salt solutions.

STANLEY COBB—2. Microscopic demonstration of capillary injection of the brain.

H. S. FORBES—2. Demonstration of the cerebral circulation in living cats.

The new electrophysiology center will be open for inspection to any who are interested in the physiology of the nervous system.

THORNDIKE MEMORIAL—BOSTON CITY HOSPITAL

Tuesday and Thursday, 2:30

GEORGE R. MINOT. Treatment of pernicious anæmia.

DRS. MINOT, WEARN and others. Epilepsy; capillary circulation; achylia gastrica; anæmia and disorders of the blood; cardiovascular diseases; metabolism; bacteriology.

R. P. STRONG. Demonstration of certain tumors of parasitic origin.

PHILIP DRINKER. New methods of artificial respiration.

SURGICAL LABORATORY—MASSACHUSETTS GENERAL HOSPITAL

Tuesday and Thursday, 2

M. A. MCIVER. Experimental problems in connection with intestinal obstruction.

J. C. WHITE. Subject to be announced.

R. H. SMITHWICK. Circulatory disorders of the extremities.

MASSACHUSETTS GENERAL HOSPITAL

Wednesday, 9

A. V. BOCK. Studies on the physiology of muscular work in health and disease.

J. C. AUB. Investigations in calcium metabolism bearing on bone growth and repair.

W. O. THOMPSON. Studies on thyroid disease; iodine dosage in exophthalmic goiter, thyroxin in myxœdema.

C. M. JONES. Acid and base secretions by the stomach; reference of pain from the gastro-intestinal tract.

WARREN MUSEUM

Open daily from 2 to 4 p.m.

Demonstrations by DR. M. CANAVAN, Curator

Dwight collection of spines illustrating deformities, anomalies, diseases.

Bone tumors, with X-ray, histories, and microscopic slides and microscopes available for examination. Some of these specimens were used in the illustrations in the monograph on "Bone Sarcoma" issued by the American College of Surgeons.

Models showing various types of club feet and effects of operation.

The pictures in Dr. Nichols' collection illustrating pathological conditions of bone.

Fractures and dislocations of bones as they existed before industrial plants provided so many safeguards.

Tuberculosis of bones and joints.

Syphilis of bones.

Dislocation of ends of bones.

Collection of old surgical instruments, obstetrical forceps, turn keys for extracting teeth, urological tools, cupping and leeching instruments.

HUNTINGTON MEMORIAL HOSPITAL

Wednesday—2, Dry clinics

E. M. DALAND and G. W. TAYLOR. Carcinoma of the skin.

C. C. SIMMONS and C. C. LUND. Cancer of the tongue and buccal mucosa.

G. A. LELAND and J. V. MEIGS. Carcinoma of the cervix.

R. B. GREENOUGH and C. C. SIMMONS. Varying degrees of malignancy in cancer.

WILLIAM M. SHEDDON and E. P. HAYDEN. Cancer of the rectum.

E. M. HERMAN and H. V. KAZANJIAN. Cancer of the antrum and accessory sinuses.

Thursday—2, Dry clinics

W. DUANE and J. C. HUDSON. The modern X-ray plant.

E. M. DALAND and W. M. SHEDDON. Cancer of the lip.

G. G. SMITH. Carcinoma of the genito-urinary tract.

R. B. GREENOUGH and C. C. SIMMONS. Carcinoma of the breast.

C. C. SIMMONS. Malignant bone tumors.

E. M. DALAND and C. C. LUND. Electrocoagulation in the treatment of malignant disease.

NEW ENGLAND DEACONESS HOSPITAL

D. F. JONES and LELAND MCKITTRICK—9, daily. General surgical clinic, operations and demonstration of cases.

F. H. LAHEY, H. M. CLUTE, R. L. MASON and L. F. SISE—9, daily. General surgical clinic, spinal anæsthesia, thyroid cases, operations and demonstration of cases.

D. F. JONES and LELAND MCKITTRICK—2, daily. Dry clinic: Cancer of the large intestine; surgery of diabetics.

E. P. JOSLIN, F. G. BRIGHAM, H. F. ROOT, PRISCILLA WHITE and W. STANLEY CURTIS—2:30, daily. Treatment of the surgical diabetic; diabetes and hyperthyroidism.

F. H. LAHEY, H. M. CLUTE and R. L. MASON—3, daily. Dry clinic: Œsophageal diverticulum; heart failure and hyperthyroidism; cancer of the thyroid; fascial sutures in hernia repair; thyroid crises.

SARA M. JORDAN—3:40, daily. Indications for surgery in peptic ulcer.

L. M. HURXTHAL—3:50, daily. Cardiac conditions complicating surgery.

L. B. MORRISON—4, daily. X-ray demonstrations, diagnosis and therapeusis.

FORSYTH DENTAL INFIRMARY

Staff—2, daily. Surgical clinics, cleft palate operations, root resections. Demonstrations in research laboratories; effect of various diets on bone development and repair.

FREE HOSPITAL FOR WOMEN

Monday

W. P. GRAVES and DR. SMITH—2. Dry clinic: Gynecological pathology, demonstration of specimens and slides.

Tuesday

W. P. GRAVES, FRANK A. PEMBERTON and R. G. WADSWORTH—9. Gynecological operations: Amputation of cervix and cœliotomy (first state procidentia); perineorrhaphy (second stage procidentia); hysterectomy for fibroid; dilatation and curettage, cœliotomy for retroversion.

Wednesday

W. P. GRAVES, FRANK A. PEMBERTON and E. B. SHEEHAN—9. Gynecological operations: Plastic and cœliotomy (reconstruction operation); hysterectomy for fibroid; dilatation and curettage, cœliotomy for retroversion; perineorrhaphy for complete laceration of perineum.

Thursday

W. P. GRAVES, FRANK A. PEMBERTON and DR. SMITH—9. Gynecological operations: Amputation of cervix and cœliotomy for procidentia; plastic and cœliotomy for prolapse (reconstruction operation); hysterectomy for fibroid; closure of vesicovaginal fistula.

Friday

W. P. GRAVES, FRANK A. PEMBERTON and DR. SMITH—9. Gynecological operations: Hysterectomy for cancer; dilatation and curettage and application of radium for cancer. Dry clinic: Demonstration of cancer cases treated.

CARNEY HOSPITAL

Monday

A. R. MACAUSLAND—2. Dry clinic: Traumatic injuries of the hip joint, illustrated.
H. G. LEE—2. Dry clinic: Fractures of the femoral shaft and of the table of tibia; wrist joint arthroplasties.
D. F. MAHONEY—2. Dry clinic: Radical operations for carcinoma of the breast and perforating duodenal ulcer, with presentation of cases.

Tuesday

F. B. LUND, A. MCK. FRASER and associates—9. Surgical operations.
F. W. JOHNSON, L. E. PHANEUF and associates—9. Gynecological and obstetrical operations.
A. L. BRETT—2. Dry clinic: Ununited fracture of neck of femur; bone screws in fractures; fusion of spine.
F. B. LUND, E. J. DENNING and W. E. BROWNE—2. Dry clinic: chronic duodenal ulcer.
F. W. JOHNSON—2. Dry clinic: End-results following interposition operation for uterine prolapse (lantern slides).

Wednesday

D. F. MAHONEY, W. E. BROWNE and associates—9. General surgical operations.
F. W. JOHNSON, L. W. PHANEUF and associates—9. Gynecological and obstetrical operations.
P. N. JEPSON—2. Dry clinic: Relative value of various types of operative bone splinting, including the massive bone graft; treatment of chronic arthritis of the spine, operative and non-operative; incidence, recognition and treatment of spondylolisthesis; over-correction of deformities in fractures.
A. MCK. FRASER—2. Dry clinic: Cæcostomy in acute appendicitis with peritonitis, presentation of cases.
L. E. PHANEUF—2. Dry clinic: The low or cervical cæsarean section (lantern slides).

Thursday

F. B. LUND, A. MCK. FRASER and associates—9. General surgical operations.
F. W. JOHNSON, L. F. PHANEUF and associates—9. Gynecological and obstetrical operations.
W. R. MACAUSLAND—2. Dry clinic: Mobilization of the knee and elbow.
M. H. BLOOMBERG—2. Dry clinic: Scoliosis and club foot.
E. J. DENNING—2. Dry clinic: Postoperative medical problems; pre-operative treatment in cardiac cases.
L. E. PHANEUF—2. Dry clinic: Uterine bleeding (lantern slides).

Friday

D. F. MAHONEY, W. E. BROWNE and associates—9. General surgical operations.
F. W. JOHNSON, L. E. PHANEUF and associates—9. Gynecological and obstetrical operations.
A. SARGENT and B. A. GODVIN—2. Orthopedic clinic.
E. J. DENNING—2. Dry clinic: Intestinal parasites in immigrants.
W. E. BROWNE—2. Dry clinic: Fractures and injuries of hand and forearm; presentation of special splints.
L. E. PHANEUF—2. Dry clinic: Appendicitis and pregnancy.

ROBERT BRIGHAM HOSPITAL

Tuesday

H. A. NISSEN—2. Focal infection in chronic arthritis; gastro-intestinal studies.
H. T. SWAIM—3. Types of arthritis with X-ray studies and orthopedic principles in the treatment.

Wednesday

P. D. WILSON—2. Operation for knee deformities.
L. T. SWAIM—3. Demonstration of orthopedic apparatus.

Thursday

L. M. SPEAR—2. Circulatory conditions in arthritis.
L. T. BROWN—3. Mechanical conditions of the low back.

Friday

P. D. WILSON—2. Orthopedic operations and demonstration of cases; orthopedic principles in the treatment of chronic arthritis.

CAMBRIDGE HOSPITAL

Tuesday

Staff—9. General surgical clinics, operations and demonstration of cases.

Wednesday

J. W. SEVER and F. A. FINDLAY—9. Orthopedic clinic, operations and demonstration of cases.

Friday

Staff—9. General surgical clinics, operations and demonstration of cases.

MASSACHUSETTS HOMEOPATHIC HOSPITAL

Monday

T. E. Chandler and H. J. Lee—2. General surgical clinic: Operations and demonstration of cases.

Tuesday

C. T. Howard and C. Crane—9. Surgical operations.
R. C. Wiggin and S. N. Vose—9. Urological operations.
S. W. Ellsworth—10. X-ray demonstration.
S. R. Meaker—10. Gynecological clinic.
J. E. Briggs and W. K. S. Thomas—2. General surgical operations.

Wednesday

T. E. Chandler and C. D. Harvey—9. Surgical operations.
A. G. Howard, S. L. Marnoy and L. G. Howard—9. Orthopedic operations.
C. T. Howard and H. J. Lee—2. Surgical operations.
L. F. Johnson—2. Bronchoscopic clinic.

Thursday

J. E. Briggs and C. Crane—9. Surgical operations.
S. R. Meaker—10. Gynecological clinic.
S. W. Ellsworth—10. X-ray demonstration.
C. T. Howard and W. K. S. Thomas—2. Surgical operations.

Friday

T. E. Chandler and C. Crane—9. Surgical operations.
J. E. Briggs and H. J. Lee—2. Surgical operations.

ST. ELIZABETH'S HOSPITAL

Tuesday

G. F. Keenan—9. Surgical clinic: Appendectomy; hysterectomy.
Joseph Stanton—9. Surgical clinic: Thyroid cases; gastro-enterostomy.
W. F. Dolan—9. Surgical clinic: Inguinal hernia.
C. J. Kickham—9. Prolapse of uterus.
F. T. Jantzen—9. Inguinal hernia under local anæsthesia.
H. S. Rowen—9. Appendectomy.
A. L. Chute and B. D. Wetherell—2. Dry clinic; Genito-urinary cases, end-results and unusual roentgenograms.
T. J. Scanlan—2. Gynecological examinations.
Pierce Dunphy—2. Cases of cancer of cervix; operation and X-ray therapy, one to four years after operation.
Pierce McGann—2. Postoperative hypospadias.

Wednesday

F. T. Jantzen—9. Surgical clinic: Appendectomy; cholecystectomy.
G. F. Keenan—9. Surgical clinic: Cholecystectomy.
Pierce Dunphy—9. Perineal plastic; cæsarean section.
Joseph Stanton—9. Thyroid cases.
R. Sullivan—9. Knee cartilage.
T. F. Broderick—9. Reconstruction of hip; plastic on knee joint.
T. F. Broderick and R. F. Sullivan—2. Dry clinic: End-results in spinal fusion for tuberculosis, scoliosis, and anatomical anomalies; end-results in plastic cases for relief of deformity.
F. T. Jantzen—2. End-results in fractures, operative and non-operative; colloidal lead treatment for malignant diseases.
Dr. Healey—2. Interesting roentgenograms.
John Dunphy—2. Surgical aspects of pediatrics.

Thursday

T. F. Broderick—9. Surgical clinic: Spinal fusion.
A. L. Chute—9. Prostatectomy; tumor of bladder; nephrectomy.
Joseph Stanton—9. Gastro-enterostomy; cholecystectomy; appendectomy.
H. S. Rowen—9. Hysterectomy.
G. F. Keenan—9. Ovarian cyst.
A. H. Crosbie—9. Nephrectomy.
Joseph Stanton—2. Dry clinic: Hour-glass stomach; fibroma of colon, with intermittent intussusception; carcinoma of appendix.
J. J. Sullivan—2. Toxæmia following administration of alkalies for treatment of duodenal ulcer.
L. J. Louis—2. Postoperative pancreatic cyst.
H. S. Rowen—2. Surgical cases.

Friday

L. J. Louis—9. Surgical clinic: Appendectomy; cholecystectomy.
H. S. Rowen—9. Cholecystectomy.
Joseph Stanton—9. Appendectomy; hysterectomy.
G. F. Keenan—9. Ventral hernia; appendectomy.
C. J. Kickham—9. Cæsarean section.
F. T. Jantzen—9. Inguinal hernia under local anæsthesia.
G. F. Keenan—2. Dry clinic: Postoperative fracture of skull; postoperative extensive resection of chest.
M. H. Spellman—2. End-results in fractures of skull.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

Tuesday

L. D. Adams, B. L. Atwood and Grace Rochford—9. Gynecological operations.
B. L. Atwood, E. Macnaughton, Marion Nute—9. Cæsarean section; operative deliveries if available.

Wednesday

Marion Nute—9. Demonstration of unusual obstetrical cases; nursery and ward walk; prenatal clinic.
L. D. Adams, B. L. Atwood and Grace Rochford—9. Gynecological operations.

Thursday

Grace Rochford and Olga Leary—9. Demonstration of postoperative cases; pathological specimens.
Eveline B. Lyle and E. Wright—9. Demonstration of border-line cases.

CLINICS ON INDUSTRIAL SURGERY

At these clinics, to be held in the office of the Medical Director of the American Mutual Liability Insurance Company, cases will be shown to illustrate diagnosis, treatment and end-results.

Tuesday

Ernest A. Codman—2. Shoulder injuries.
Edward L. Young—4. Inguinal pain without hernia.

Wednesday

Fred J. Cotton—2. Reconstruction surgery in industry.
John D. Adams—4. Injuries to the back.

Thursday

P. D. Wilson—2. Fractures of the os calcis; injuries to the knee.
Rudolph Jacoby—4. Industrial dermatology.

Friday

John D. Hodgson—2. Fracture of the skull.
Harry C. Solomon—3. Industrial neurology.
Henry C. Marble—4. Hernia.

PALMER MEMORIAL HOSPITAL

Tuesday

Staff—2. Deep X-ray therapy clinic; demonstration of prevention of peritoneal adhesions; pathological demonstration.

SHIELDS WARREN—2. Prevention of peritoneal adhesions by amniotic fluid; experimental and clinical results.

Wednesday

Staff—9. Operations illustrating treatment of various types of malignancy.

Thursday

L. S. MCKITTRICK, DR. MCCLURE and DR. BENEDICT—2. Follow-up and radium clinics, general surgery.

SHIELDS WARREN—2. Prevention of peritoneal adhesions by amniotic fluid; experimental and clinical results.

Friday

GEORGE A. LELAND, JR. and J. V. MEIGS—2. Follow-up and radium clinics, gynecology.

CHILDREN'S HOSPITAL

Monday

R. B. OSGOOD, W. E. LADD and associates—2. Fracture conference, combined surgical and orthopedic services.

Tuesday

Surgical staff—9. General surgical operations followed by dry clinic.

WILLIAM E. LADD. Hare lip and cleft palate.

C. G. MIXTER. Contractures and plastics.

H. W. HUDSON. Angiomata.

G. D. CUTLER and KENNETH BLACKFAN. Medical aspects of empyema and lung abscess.

Orthopedic staff—2. Dry clinic, infantile paralysis.

W. L. AYCOCK and E. H. LUTHER. Epidemiology, occurrence, serum treatment.

S. M. FITCHET. Demonstration of apparatus for prevention of deformity in early cases.

MISS MERRILL. Muscle training.

FRANK OBER. Tendon transplantation.

E. W. RYERSON (Chicago) and A. T. LEGG. Stabilizing operations.

A. T. LEGG. Operations.

FRANK OBER. Moving pictures.

Wednesday

W. E. LADD, R. B. OSGOOD and associates—9. Combined clinic of surgical and orthopedic services, present policies in the treatment of glandular, intra-abdominal, bone, and joint tuberculosis.

R. B. OSGOOD, W. E. LADD and associates—2. Combined clinic of surgical and orthopedic services, osteomyelitis, acute, chronic, circumscribed; Brodie's abscess; septic joints; types of infection and treatment.

Thursday

Orthopedic staff—9. Dry clinic.

ALFRED TAYLOR (New York) and J. W. SEVER. Conference on obstetrical paralysis with lantern slides and moving pictures.

FREEMAN ALLEN, F. SMITH (New York), W. B. CANNON and A. H. BREWSTER. Conference on spastic palsy.

BRONSON CROTHERS and MISS TRAINOR. Muscle training.

A. H. BREWSTER. Stoeffel operation.

Surgical staff—2. General surgical operations followed by dry clinic.

C. G. MIXTER. Urinary obstruction and infection.

W. E. LADD. Kidney stone.

THOMAS LANMAN. Hernia and undescended testicle.

C. G. MIXTER and S. B. WOLBACH. Kidney tumors, pathological aspects.

Friday

Surgical staff—9. General surgical clinic.

WILLIAM E. LADD. Pyloric stenosis.

G. D. CUTLER. Idiopathic peritonitis.

AUGUSTUS THORNDIKE. Appendicitis.

C. G. MIXTER. Intussusception.

WILLIAM E. LADD. Obliteration of bile ducts.

Orthopedic staff—2. Dry clinic.

ELLIOTT G. BRACKETT (Cincinnati) and H. J. FITZSIMMON. Conference on torticollis followed by operation.

F. D. DICKSON (Kansas City) and R. SOUTTER. Conference on congenital dislocation of hip followed by closed reduction and shelf operation.

NEW ENGLAND BAPTIST HOSPITAL

Tuesday

E. L. YOUNG, JR., D. L. JACKSON, H. B. LODER and D. J. BRISTOL, JR.—9. General surgical clinic, operations and demonstration of cases.

Wednesday

F. H. LAHEY and H. M. CLUTE—9. Surgical operations.

SARA M. JORDAN and E. KIEFER—2. Gastro-enterological clinic.

Thursday

E. L. YOUNG, JR., D. L. JACKSON, H. B. LODER and D. J. BRISTOL, JR.—9. General surgical clinic, operations and demonstration of cases.

BOSTON LYING-IN HOSPITAL

Tuesday

Staff—9. Dry clinics.

B. E. HAMILTON. Heart disease in pregnancy.

F. S. NEWELL. Treatment of pregnancy complicated by heart disease.

S. BERMAN. End-results in pre-eclamptic toxæmia.

F. C. IRVING. Treatment of pre-eclamptic toxæmia by removal of blood plasma and reinfusion of corpuscles.

E. G. CRABTREE. Clinical aspects of pyelitis in pregnancy.

G. C. PRATHER. The postpartum bladder.

Wednesday

Staff—9. Obstetrical operations.

BETH ISRAEL HOSPITAL

WYMAN WHITTEMORE and associates—9, daily. General surgical clinic.

E. G. CRABTREE—9, daily. Urological clinic.

MARK ROGERS—9, daily. Orthopedic clinic.

HERMAN BLUMGARD. Demonstration in medical research department.

BOSTON UNIVERSITY SCHOOL OF MEDICINE

(Evans Memorial Building)

S. R. MEAKER and A. W. ROWE—2, Wednesday and Friday. Studies in sterility.

A. W. ROWE and C. H. LAWRENCE—2, Wednesday and Friday. Endocrinology.

TUFTS COLLEGE MEDICAL SCHOOL

TIMOTHY LEARY—2, daily. Demonstration of specimens illustrating results of traumatism, especially cranial and cerebral.

SURGERY OF THE EYE, EAR, NOSE, AND THROAT

CLINICAL DEMONSTRATIONS

Tuesday, 2 P.M.—Georgian Room, Statler Hotel

C. B. FAUNCE, M.D., Boston: Brain Abscess Cases; Lipiodol Injections in Brain Abscess.

H. P. CAHILL, M.D., Boston: Report of a Case of Cerebellar Abscess.

D. C. SMYTH, M.D., Boston: Lipiodol Injections in Lung Abscess.

LOUIS M. FREEDMAN, M.D., Boston; Lipiodol Injections in Lung Abscess and Maxillary Antra.

E. W. HERMAN, M.D., Boston: Two Cases of Foreign Body in the Tracheo-Œsophageal Wall.

H. G. TOBEY, M.D., Boston: The Results of the Examination and Treatment of 1000 Cases of Asthma.

J. M. WHEELER, M.D., New York, E. V. L. BROWN, M.D., Chicago, and GEORGE S. DERBY, M.D., Boston: Our Mistakes in Ophthalmology.

Wednesday, 2 P.M.—Georgian Room, Statler Hotel

Presentation of manual dealing with minimum requirements for general hospitals caring for ophthalmological, rhinological and otolaryngological patients. See detailed program under "Hospital Conference."

Thursday, 2 P.M.—Georgian Room, Statler Hotel

D. H. WALKER, M.D., Boston: Lip Reading and the Deaf Child; Aids to Hearing.

C. D. KNOWLTON, M.D., Boston: Animal Studies in the Regeneration of the Antral Mucous Membrane.

L. A. SCHALL, M.D., Boston: Microscopic slides illustrating pathological conditions of the antrum.

D. W. DRURY, M.D., Boston: The Results of Metabolism Tests in Cases of Chronic Deafness.

T. B. HOLLOWAY, M.D., Philadelphia: Vascular Relations at the Base of the Brain.

F. H. VERHOEFF, M.D., Boston: Ophthalmic Pathology.

Friday, 2 P.M.—Georgian Room, Statler Hotel

J. H. WAITE, M.D., Boston: Diagnosis in Glaucoma.

W. B. LANCASTER, M.D., Boston: Operation vs. Miotics.

A. GREENWOOD, M.D., Boston: Handling of Secondary Glaucoma.

H. P. CAHILL, M.D., Boston: Lantern slide demonstration of serial sections of the ear.

F. E. GARLAND, M.D., Boston: Infection of the Submaxillary Gland; Discussion of Treatment.

V. H. KAZANJIAN, M.D., Boston: Plastic Operations on the Tip of the Nose.

H. P. MOSHER, M.D., Boston: Report of a Case of Cavernous Sinus Thrombosis; Description of Operation, Autopsy Findings (Microscopical slides showing the pathological findings in both eyes).

MASSACHUSETTS EYE AND EAR INFIRMARY

Tuesday

Ophthalmology

Staff—9. Operations and demonstrations of cases.
J. M. WHEELER. Plastic surgery.
G. S. DERBY. Eye operations.
H. B. C. RIEMER—Tear sac operations.
J. H. WAITE. Slit-lamp demonstration.
E. B. DUNPHY. External diseases.
B. SACHS. Perimetry.
H. K. MESSENGER. Physiological optics.
PAUL CHANDLER. Light sense.
T. L. TERRY. Pathology.
IDA E. RIDGEWAY. Sight-saving class.

Otolaryngology

H. A. BARNES—9. Malignant disease of the accessory sinuses, exhibition of cases.
H. G. TOBEY—9. Simple mastoid operation.
PHILIP HAMMOND—9. Radical mastoid operation.
H. P. CAHILL—10. Wire gauze brain drain; paraffin basket for skin graft of the radical mastoid cavity; lantern slide demonstration of brain cases.
DR. WRIGHT—10. The teeth and iritis.
G. L. TOBEY—11. Lateral sinus thrombosis; the manometer test.
F. M. RACKEMANN—11. Demonstration of method for making tests for anaphylaxis.

Wednesday

Otolaryngology

G. H. POIRIER—9. Mosher-Toti lachrymal sac operation.
C. T. PORTER—10. Tonsillectomies: Dissection and snare.
G. H. POIRIER—10. Tonsillectomies: Sluder technique.
H. P. CAHILL—10. Tonsillectomies: LaForce technique.
P. E. MELTZER—10. Tonsillectomies: Removal with cautery snare.
A. S. MACMILLAN—11. Demonstration of accessory sinus and mastoid X-rays.

Ophthalmology

Staff—9. Operations and demonstrations of cases.
W. B. LANCASTER. Eye operations.
J. B. AYER and G. S. DERBY. Nerve-eye clinic.
MAUDE CARVILL. Ocular tuberculosis.
J. H. WAITE. Gullstrand ophthalmoscope.
P. A. CHANDLER. Perimetry.

B. SACHS. External diseases.
H. K. MESSENGER. Physiological optics.
PAUL CHANDLER. Light sense.
T. L. TERRY. Pathology.
IDA E. RIDGEWAY. Sight-saving class.

Thursday

Otolaryngology

V. H. KAZANJIAN—9. Plastic operations.
D. C. SMYTH—9. Dry clinic: The fluoroscope and the removal of metallic foreign bodies; safety pin cases.
DR. KIRBY—9. Bárány fallacies.
H. P. MOSHER—10. Exhibition of œsophageal instruments; demonstration of the fluoroscopic examination of the œsophagus.
A. S. MACMILLAN—11. Lantern slide demonstration of œsophageal cases.

Ophthalmology

Staff—9. Operations and demonstrations of cases.
T. B. HOLLOWAY. Thyroid-eye cases.
A. GREENWOOD. Eye operations.
S. J. BEACH. Refraction with angular type.
W. B. LANCASTER. Muscles.
H. B. C. RIEMER. External diseases.
E. B. DUNPHY. Perimetry.
H. K. MESSENGER. Physiological optics.
PAUL CHANDLER. Light sense.
T. L. TERRY. Pathology.
IDA E. RIDGEWAY. Sight-saving class.

Friday

Ophthalmology

Staff—9. Operations and demonstrations of cases.
F. H. VERHOEFF. Eye operations.
W. H. LOWELL. Muscles.
AMY SMITH. Social work.
H. K. MESSENGER. Physiological optics.
PAUL CHANDLER. Light sense.
T. L. TERRY. Pathology.
IDA E. RIDGEWAY. Sight-saving class.

Otolaryngology

V. H. KAZANJIAN—9. Dry clinic: Correction of deformities of the face and nose, lantern slide demonstration.
H. P. MOSHER—10. Dry clinic: Punch tracheotomy.
A. S. MACMILLAN. X-ray of thymus (lantern slides).
F. E. GARLAND—11. Historical exhibit of laryngeal instruments.

HARVARD MEDICAL SCHOOL

Tuesday

LUCIEN HOWE—2. Ophthalmic ergograph, writes automatically the story of ocular fatigue and relation of this fatigue to "eye strain."
H. P. MOSHER—2. Mosher-Toti lachrymal sac operation; demonstration on cadaver.
C. B. FAUNCE and P. E. MELTZER. Anatomical exhibit of temporal bone specimens.

Thursday

LUCIEN HOWE—2. Ophthalmic ergograph, writes automatically the story of ocular fatigue and relation of this fatigue to "eye strain."
H. P. MOSHER—2. Demonstration of methods in postgraduate teaching of laryngology.
M. H. LURIE—3. Exhibition of temporal bone specimens.

CHILDREN'S HOSPITAL

Tuesday

LYMAN G. RICHARDS and associates—9. Dry clinic: Lye stricture of the œsophagus. Fulminating infection of the antrum in children. Modified radical mastoid operation in children.
LYMAN G. RICHARDS, EDWIN A. MESERVE and DR. CLINE—10. Nose and throat operations.

Wednesday

LYMAN G. RICHARDS and associates—9. Sinus thrombosis in retrospect. Some thoughts on postoperative healing in acute mastoiditis. Typhoid fever and mastoiditis in children.
LYMAN G. RICHARDS, EDWIN A. MESERVE and DR. CLINE—10. Nose and throat operations.

Thursday

LYMAN G. RICHARDS and associates—9. Dry clinic: Some bronchial foreign bodies and experiences attending their removal. A group of laryngeal obstructions with tracheotomic complications. Bronchiectasis in children.
LYMAN G. RICHARDS, EDWIN A. MESERVE and DR. CLINE—10. Nose and throat operations.

CARNEY HOSPITAL

Tuesday

WILLIAM LIEBMAN—9. Eye operations and demonstration of cases; X-ray localization and magnet extraction of foreign bodies.

Wednesday

E. D. HURLEY and W. S. LIEBMAN—9. Eye operations and demonstration of cases.

Thursday

WILLIAM LIEBMAN and H. BORNCHOFF—9. Eye operations and demonstration of cases.

Friday

W. J. SHEEHAN and F. G. MINITER—2. Otolaryngological clinic.

MASSACHUSETTS HOMEOPATHIC HOSPITAL

Tuesday

W. D. ROWLAND—9. Eye clinic.
F. W. COLBURN and H. L. BABCOCK—9. Aural clinic.

Thursday

W. D. ROWLAND—9. Eye clinic.
C. SMITH, C. W. BUSH, E. R. JOHNSON, R. O. PARRIS and W. W. WALKER—9. Nose and throat clinic.

Friday

W. D. ROWLAND, J. E. STERNBERG, H. M. EMMONS and J. J. SKIRBALL—9. Eye clinic.

BOSTON DISPENSARY

Tuesday

H. J. INGLIS—2. Beck-Schenk snare method of tonsillectomy.

Wednesday

JOSEPH G. SKIRBALL—10. Eye clinic, demonstration of cases, external diseases, perimetry, ophthalmological co-operation with syphilis clinic.

Thursday

L. I. SKIRBALL—10. Ocular lues.

ST. ELIZABETH'S HOSPITAL

Tuesday

W. T. HALEY—9. Mastoid and tonsil cases.

Wednesday

P. S. MCADAMS—9. Enucleation of the eye.
J. BURNS—9. Tonsillectomy.

Friday

W. T. HALEY—9. Frontal sinus operation.
J. BURNS—9. Mastoid operation.
W. T. HALEY—2. End-results in radical sinus operations.

CAMBRIDGE HOSPITAL

N. S. BACON and E. J. BUTLER—9, Thursday. Nose and throat clinic.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

M. N. KLEINERT and I. D. KERR—9, Tuesday and Wednesday. Ear, nose, and throat clinic; operations and demonstration of cases.

BETH ISRAEL HOSPITAL

L. V. FRIEDMAN and L. ARKIN—9, daily. Nose and throat clinic.
WILLIAM LIEBMAN—9, Friday. Eye clinic.

BOSTON CITY HOSPITAL

J. J. CORBETT—9, daily. Eye clinic.

CARNEY HOSPITAL

E. D. HURLEY—9, daily. Eye clinic.

ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday, 10:00—Ballroom, Copley-Plaza Hotel

GEORGE D. STEWART, M.D., New York, Presiding

Address of Welcome. FREDERIC A. WASHBURN, M.D., Boston; Director, Massachusetts General Hospital.

The Rôle of the American College of Surgeons in Improving Hospital Service. GEORGE D. STEWART, M.D., New York, President, American College of Surgeons.

Presentation of Annual Report of Hospital Standardization and Announcement of Approved List for 1928. M. T. MACEACHERN, M.D., Chicago; Associate Director, American College of Surgeons and Director of Hospital Activities.

Health Inventoriums in Approved Hospitals—Further Progress of Research. FRANKLIN H. MARTIN, M.D., Chicago; Director-General, American College of Surgeons.

The Interest and Influence of the Duke Endowment in Hospital Standardization. W. S. RANKIN, M.D., Charlotte, N. C.; Director, The Duke Endowment.

Nurses, Patients and Pocketbooks. MAY AYERS BURGESS, Ph.D., New York; Director, Committee on the Grading of Nursing Schools.

General Discussion. CHARLES F. WILINSKY, M.D., Boston, Director of Beth Israel Hospital; WILLIAM DARRACH, M.D., New York; Dean, College of Physicians and Surgeons, Columbia University; MARY M. ROBERTS, R.N., New York; Editor, American Journal of Nursing; and CHARLES H. MAYO, M.D., Mayo Clinic.

Monday, 2:00—Ballroom, Copley-Plaza Hotel

GEORGE D. STEWART, M.D., New York, Presiding

Missed Pedagogic Opportunities Incident to the Usual Organization of the Resident Medical Staff of the Hospital. HENRY A. CHRISTIAN, M..D, Boston; Hersey Professor Theory and Practice of Physic, Harvard University Medical School.

Medical Education and Specialization. WILLARD C. RAPPLEYE, M.D., New Haven; Director of Study, Commi-sion on Medical Education.

Experimental Science versus Imitative Art in Medicine. E. MURRAY BLAIR, M.D., Vancouver, B.C.

What Is the Rôle of the Hospital Administrator? F. E. CHAPMAN, Cleveland; Director, Mt. Sinai Hospital.

Visual Methods in Conducting the Staff Conference (Illustrated). C. G. PARNALL, M.D., Rochester, N. Y.; Director, Rochester General Hospital; President-elect, American Hospital Association; and HARRY D. CLOUGH, M.D., Rochester, N.Y.; Assistant Medical Director, Rochester General Hospital.

General Discussion. CHARLES H. YOUNG, M.D., Portland, Maine; Director, Maine General Hospital; and JOHN T. BURRUS, M.D., High Point, N.C.; Surgeon, High Point Hospital.

Tuesday, 9:30—Ballroom, Copley-Plaza Hotel

JOSEPH B. HOWLAND, M.D., Boston; Superintendent, Peter Bent Brigham Hospital, Presiding.

The Educational and Economic Value of the Out-patient Department in a General Hospital. JAMES RAGLAN MILLER, M.D., Hartford; Assistant Gynecologist and Obstetrician, Hartford Hospital.

Selective Economic Basis for Out-patient Service (Illustrated). BEATRICE KAISER, Detroit; Clinic Executive, Harper Hospital.

Minimum Standards for the Hospital Social Service Department. MABEL R. WILSON, R.N., Boston; Director Social Service Department, Children's Hospital.

The Operation of a Physical Therapy Department from the Scientific and Economic Standpoints. JOHN S. COULTER, M.D., Chicago; Assistant Professor of Physical Therapy, Northwestern University Medical School.

Discussion. MICHAEL M. DAVIS, Ph.D., New York; Consultant, Hospital and Community Surveys; and FRANK GRANGER, M.D., Boston; Director of Physical Therapy Department, Boston City Hospital.

Tuesday, 2:00—Ballroom, Copley-Plaza Hotel

Clinic on Case Records in Hospitals. Directed by C. W. MUNGER, M.D., Valhalla, N. Y.; Director, Grasslands Hospital.

What Constitutes a Good Case Record? ERNEST LEROI HUNT, M.D., Worcester; Surgeon and Director of Surgical Services, Worcester City Hospital.

What Are the Best Methods of Appraising Case Records? HAROLD W. HERSEY, M.D., Bridgeport; Superintendent, Bridgeport Hospital.

What Part Should the Record Librarian Play in Promoting Efficient Case Records in the Hospital? GRACE W. MYERS, Boston; Librarian Emeritus, Massachusetts General Hospital.

How Best Can Good Case Records Be Maintained in the Small Hospital Where the Usual Difficulties—Lack of Internes, Shortage of Funds, and No Historian or Record Librarian—Are Frequently Found? CLARA A. DOOLITTLE, Derby, Conn.; Historian, Griffin Hospital, and President, Connecticut Hospital Historians Association.

What Are the Most Effective Ways and Means of Stimulating Good Case Records? EMMA C. BLACK, New Haven Record Librarian, Grace Hospital.

What Should Be the Functions of a Record Committee of the Medical Staff? E. W. WILLIAMSON, M.D., Chicago; Chief Field Representative, American College of Surgeons.

What Are the Most Effective Means of Keeping Current Case Records up to Date? R. C. BUERKI, M.D., Madison; Superintendent, Wisconsin General Hospital.

What Are the Relative Advantages or Disadvantages of the Various Filing Systems? EDITH M. ROBBINS, Boston; Chief Record Librarian, Peter Bent Brigham Hospital.

The Organization and Functioning of a Central Record Department. GENEVIEVE CHASE, Boston; Record Librarian, Massachusetts General Hospital.

Wednesday, 9:30—Ballroom, Copley-Plaza Hotel

Open Forum—Problems Involved in the Professional Care of the Patient. Directed by LEWIS A. SEXTON, M.D., Hartford; Superintendent, Hartford Hospital.

Measuring the Professional Efficiency of the Hospital. JOSEPH C. DOANE, M.D., Philadelphia, Superintendent, Philadelphia General Hospital.

Standard of Surgical Efficiency. GEORGE W. SWIFT, M.D., Seattle; Surgeon, Children's Orthopedic and King County Hospitals.

Medical Staff Organization. T. T. MURRAY, Albany; Superintendent, Memorial Hospital.

Relation of the Clinical Pathologist to the Medical Staff and the Scientific Work of the Hospital. J. J. MOORE, M.D., Chicago; Director, National Pathological Laboratory.

Responsibility of Hospital Trustees for the Professional Care of the Patient. JOSEPH J. WEBER, New Haven; Superintendent, Grace Hospital.

Follow-Up. FRANK E. WING, Boston; Director, Boston Dispensary.

Appraisal of Nursing Service. MIRIAM CURTIS, Northampton; Superintendent, Cooley-Dickinson Hospital.

The Clinico-Pathological Conference as an Educational Factor in the Hospital. JOHN E. RANSOM, Toledo; Superintendent, Toledo Hospital.

General Discussion. T. R. PONTON, M.D., Chicago; Managing Director, American Hospital.

Wednesday, 2:00—Georgian Room, Statler Hotel

GEORGE S. DERBY, M.D., Boston; Professor of Ophthalmology, Harvard University, Medical School, Presiding.

Presentation of Manual Dealing with Minimum Requirements for General Hospitals Caring for Ophthalmological, Rhinological, and Oto-Laryngological Patients. JOSEPH C. BECK, M.D., Chicago; Associate Professor of Oto-Laryngology, University of Illinois College of Medicine.

Discussion. ROBERT C. LYNCH, M.D., New Orleans; Professor of Oto-Laryngology, Tulane University of Louisiana Post-Graduate School of Medicine.

Round Table Conference—Every-Day Problems as Related to the Care of Ophthalmological, Rhinological, and Oto-Laryngological Patients in General Hospitals. Directed by PERRY G. GOLDSMITH, M.D., Toronto; Professor of Oto-Laryngology, University of Toronto Faculty of Medicine.

What Should Constitute a Minimum Basic Training for One or the Other of the Specialties Represented in this Section? T. J. HARRIS, M.D., New York; Consulting Surgeon, Throat Department, New York Post-Graduate Medical School and Hospital.

Should All Internes Receive Practical Experience in the Eye, Ear, Nose and Throat Department? HORACE J. WHITACRE, M.D., Tacoma, Wash.; Surgeon General Hospital.

Should All Student Nurses Receive Practical Experience in the Eye, Ear, Nose and Throat Department? If So, to What Extent? GRACE E. ALLISON, Troy, N. Y.; Superintendent, Samaritan Hospital.

Is It Advisable and Practical to Standardize Routine Procedures as well as Dressings and Supplies Pertaining to the Work of these Specialties? WALTER H. SNYDER, M.D., Toledo; Ophthalmologist and Chief of Staff, Flower Hospital.

How Can an Efficient Anæsthesia Service Be Maintained for the Eye, Ear, Nose and Throat Department? FREEMAN ALLEN, M.D., Boston; Anæsthetist, Massachusetts Eye and Ear Infirmary.

In the Absence of the Attending Doctor and When There Is No Interne or Resident What Emergency Measures Can the Hospital Personnel Carry out in Case of Hæmorrhage following Tonsillectomy, or other Accidents Which Might Follow in the Work of these Specialties? JOHN O. MCREYNOLDS, M.D., Dallas; Ophthalmic and Aural Surgeon, St. Paul's Sanitarium.

How Long, on the Average, Should Tonsil Cases Be in the Hospital Pre- and Postoperative? Should All Cases of Discharging Ears or Sinuses of Unknown Origin Be Segregated from Other Patients? WILLIAM ARRELL, M.D., Hamilton, Ontario; Visiting Surgeon, Hamilton General Hospital.

When Building a Hospital Should the Operating Rooms for the Eye, Ear, Nose and Throat Department Be Located in the General Surgery Suite or in the Department with the Wards? DAVID H. BALLON, M.D., Montreal; Demonstrator in Oto-Laryngology, McGill University Faculty of Medicine.

What Routine Laboratory Examinations Should Be Required in the Work of the Eye, Ear, Nose and Throat Department? SHIELDS WARREN, M.D., Boston; Pathologist, New England Deaconess Hospital.

Wednesday, 2:00—Ballroom, Copley-Plaza Hotel

Open Forum—The Small Hospital and Hospital Standardization. Directed by PAUL FESLER, Minneapolis; Superintendent, University Hospitals.

What the Duke Endowment Is Doing for the Small Hospital. HUBERT A. ROYSTER, M.D., Raleigh, N.C.; Surgeon, Rex and St. Agnes Hospitals.

How the Large Hospital Can Assist the Small Hospital in Complying with the Requirements. ROBERT M. HARBIN, M.D., Rome, Georgia; Surgeon, Harbin Hospital.

How the Medical Staff of the Small Hospital Can Be Organized and Function so as to Meet the Requirements. LOUIS G. PINAULT, M.D., Campbellton, N.B.; Chief Surgeon, Hotel Dieu of St. Joseph.

How the Small Hospital Can Maintain a Record System Acceptable to the American College of Surgeons. MINNIE GENEVIEVE MORSE, Plainfield, N. J.

How the Small Hospital Can Build up the Essential Special Services to a Degree Acceptable for Approval. LUCY ABBOTT, Norwich, Conn.; Superintendent, William W. Backus Memorial Hospital.

General Discussion. T. E. REEKS, M.D., New Britain, Conn.; Superintendent, New Britain General Hospital; RUTH A. BROWN, Wyandotte, Mich.; Superintendent, Wyandotte General Hospital, and W. S. RANKIN, M.D., Charlotte, N. C.; Director, the Duke Endowment.

Thursday, 9:30—Ballroom, Copley-Plaza Hotel

FULLER F. BARNES, Bristol Conn.; President, Board of Directors, Bristol Hospital, Presiding.

The Care of Obstetrical Patients in General Hospitals. JAMES F. TAYLOR, M.D., Sioux City; Member of Staff, St. Vincent's Methodist and Sioux City Maternity Hospitals.

The Care of the Convalescent Patient. JOHN BRYANT, M.D., Boston.

The Responsibility of the Hospital Administration in the Care of Fractures. CHARLES L. SCUDDER, M.D., Boston; Consulting Surgeon, Massachusetts General Hospital.

The Responsibility of the Hospital Administration in the Care of the Injured. FREDERIC A. BESLEY, M.D., Waukegan, Ill.; Professor of Surgery, Northwestern University Medical School.

Possibility of Postoperative Infections from Contamination of Water in Hospitals. ARNOLD H. KEGEL, M.D., Commissioner of Health, City of Chicago.

Beauty in the Hospital. REV. C. B. MOULINIER, S.J., Chicago; Executive Director, Catholic Hospital Association.

General Discussion. BORIS FINGERHOOD, Brooklyn; Superintendent, United Israel Zion Hospital; and THOMAS F. DAWKINS, Port Chester; Superintendent, United Hospital.

Fig. 14. Attaching ends of catheters to gauze within the bowel.

Transplantation of the Ureters into the Large Intestine.—Robert C. Coffey